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FIFTH REPORT

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Illinois State Highway Department

FOR THE

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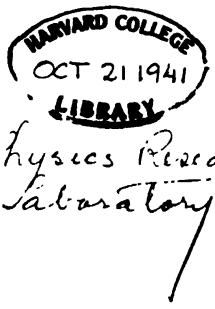

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ILLINOIS STATE HIGHWAY DEPARTMENT.

COMMISSION.

A. D. GASH, *President,* Chicago.

S. E. BRADT, *Secretary,* DeKalb.

JAMES P. WILSON, Polo.

WM. W. MARR, *Chief State Highway Engineer.*

H. E. BILGER, *Road Engineer.*

CLIFFORD OLDER. *Bridge Engineer.*

B. H. PIEPMEIER, *Maintenance Engineer.*

F. L. ROMAN, *Testing Engineer.*

J. M. MCCOY, *Chief Clerk.*

LETTERS OF TRANSMITTAL.

To His Excellency, Frank O. Lowden, Governor of the State of Illinois.

SIR: We have the honor to submit herewith a report of the State Highway Department for the years 1913, 1914, 1915 and 1916.

We desire to call your attention especially to the discussion on County Road Systems, the system of Maintenance Cost Records, the system of Auditing and Accounting for Township Road and Bridge Moneys and the system of Standard Bridge Plans developed and in use by the Department.

Very respectfully,

A. D. GASH, *President.*
S. E. BRADT, *Secretary.*
JAMES P. WILSON.
WM. W. MARR, *Chief State Highway Engineer.*

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THE ORGANIZATION AND WORK OF THE STATE HIGHWAY DEPARTMENT.

In 1913 the State Legislature passed a law revising the statutes of Illinois in relation to roads and bridges. This law provided for the laying out of a State wide system of roads to be improved at the joint expense of the State and the various counties. These roads were to be known as State aid roads. The law further created a State Highway Department with new powers and duties.

A State Highway Commission of three members was provided, to be appointed by the Governor and to have general control of the department. A Chief State Highway Engineer, also to be appointed by the Governor, was designated as the executive officer of the Commission. Such employees as were necessary to perform the work of the department were to be appointed by competitive civil service examinations.

Since the passage of this law the work of the department has grown to very large proportions, and it has recently become necessary to perfect an efficient organization, in order to meet the increased demands.

The work of the department has been divided into five character divisions or bureaus with a bureau chief in charge of each. These are respectively, the Bureau of Roads, the Bureau of Bridges, the Bureau of Maintenance, the Bureau of Tests and the Bureau of Audits. The various bureau chiefs report directly to the Chief State Highway Engineer and have responsible charge of all work relating to their respective bureaus. In order to execute the work of these bureaus effectively, it has been found necessary to subdivide the State into seven districts; each under the direction of a division engineer who is in direct charge of all work in his district. These division engineers report to the respective bureau chiefs in accordance with the character of the work involved. Each division engineer is located in a permanent office in his division, and has an organization of assistants who report directly to him in all matters. In addition to the division engineer, each bureau chief has reporting to him an office force for which he is directly responsible.

There is in this organization no conflict of authority or division of responsibility. The various assistants report to their immediate superior, and whenever an assistant has a specific branch of work assigned to him, all subordinates are directly under his control. On the other hand, no member of the department is authorized to issue instructions to any but his immediate subordinate. This arrangement operates so that authority and responsibility in all cases are clearly defined, and

the confusion, which naturally results when a superior officer attempts to direct work over the heads of intermediate officials, is obviated.

The work of the Bureau of Roads consists primarily in the preparation of plans and supervising the construction of all State aid roads. This bureau further furnishes consulting service to counties which are considering the issuing of county bonds under a special provision of the State aid law, or which are building roads under such a bond issue.

The Bureau of Bridges has supervision of the design and construction of all State aid bridge work, and in addition prepares bridge plans for the townships and counties of the State, upon request from the county superintendents of highways. In accordance with the road and bridge law this bureau further has charge of the checking and approving of all plans for bridges which are constructed in whole or in part by county funds.

The Bureau of Maintenance has charge of the maintenance of all State aid roads. This bureau further acts in a consulting capacity for county and township officials upon all matters relating to road construction or maintenance. The supervision of the distribution of the crushed stone prepared by convicts at the State penitentiaries also falls under the jurisdiction of this bureau.

The Bureau of Tests is charged with the responsibility of testing and approving all materials used in the construction or maintenance of State aid roads, and further, upon request by county or township officials, tests materials for road or bridge construction free of charge.

The Bureau of Audits has charge of all the accounting of the department and of all general business procedure. The clerical and stenographic departments are under the supervision of this bureau.

The classification of the work of the department into these various divisions, and the centering of the responsibility in the various bureau chiefs, has eliminated confusion and promoted efficiency. Owing to the vast territory in which the department operates, and the scattered condition of the work, the overhead and engineering costs have been comparatively high in the past. However as a result of the establishment of division engineers in permanent quarters and the perfection of the present organization in general, the cost of engineering has been greatly reduced, and the operation of the department placed upon an efficient basis.

The various chapters of this report were prepared by the bureau chiefs under the direction of the State Highway Commission and the Chief State Highway Engineer.

PART I

Bureau of Roads

REPORT OF BUREAU OF ROADS.

(H. E. BILGER, Road Engineer.)

ORGANIZATION.

The State Aid Road Law became effective July 1, 1913, and pending meetings of the county boards to accept the State allotment and designate the particular highways for improvement, nothing could be done in the way of making surveys and plans for the coming work. In fact it was not until the latter part of December that the necessary action had been taken to permit surveys to be made. Aside from the preparation of standard designs and road maps for each of the 102 counties, the first engineering work began with the road survey in Peoria County on December 21, 1913. Since that time the greater part of the force has been engaged in the making of surveys, plans and estimates and in the supervision of construction of State aid work. At first the survey parties worked out of the Springfield office and all plans and estimates were made there.

Soon after July 1, 1914, when the first contracts were awarded, actual construction began on many of the jobs, and in order to handle the work better the State was made into seven divisions with an engineer assigned to each. During the construction season these division engineers maintained headquarters within their divisions, and the resident engineers stationed on construction work reported directly to them.

At the end of the first season the division headquarters were discontinued and all survey and plan work was again handled in the main office in much the same manner as was done the preceding year. Tho the men from the seven divisions worked side by side and more or less in common, yet each division engineer had charge of all survey, plan and estimate work for his own division. During the season of 1915 construction work was handled in the same manner as the preceding year, but all work of the bureau had become better coordinated.

In the fall of 1915 permanent headquarters were established in each of the seven divisions. This was made necessary because of the increased appropriation for the years 1915 and 1916, as against the one for the preceding two years. Previous experience also had shown an unnecessary expense, as well as more or less confusion, due to attempting to handle so large a volume of detail road plans and estimate work from only one office located at Springfield. With a fully equipped office centrally located in his territory, the division engineer is much better prepared to take complete charge and handle more efficiently the making of surveys, plans, estimates, etc., as well as to exercise supervision over the construction work as had been done previously.

From the force assigned to him during the construction season the division engineer selects the men to be retained for survey and office work during the winter, thereby forming the nucleus of his force for the next season's work. There is thus built up in each division a corps of trained men who are familiar with the conditions local to the particular section of the State, and by whom the division engineer can be relieved of minor details of the work.

All proposed road improvements are subject to a report by the division engineer, and matters arising incident to construction work he handles directly. He authorizes partial and final payments on State aid work and makes final inspections of such work in company at times with the road engineer or Chief State Highway Engineer. In accordance with the organization of the State Highway Department, the division engineer reports directly to the road engineer on all matters pertaining to State aid road construction.

Additional to the seven division offices there is maintained at Springfield a small office force. Formerly when all drafting and computing work for road plans was done in the Springfield office during the winter months and the men were transferred to the field during the construction season, the size of the force fluctuated between wide limits. The practice of making road plans and estimates in the offices of the division engineers will enable there being maintained a force of more constant size in the Springfield office throughout the year. This force will be engaged mainly in carrying on the detail work of the bureau as outlined below.

The office work of the road engineer at Springfield consists of handling correspondence with contractors, county superintendents of highways, division engineers and other employees of the department. It consists also of employing and releasing from the service junior highway engineers engaged on State aid road work, and of re-assigning these men from place to place as occasions require in order to maintain a properly balanced force with respect to the needs of each particular branch of the work. The road engineer's office carries into practice ideas advanced by the Chief State Highway Engineer and furnishes reports to him on the progress and other features of the various jobs. The office studies the practical workings of the bureau with a view of making recommendations for such changes as would seem warranted.

It examines all plans and cost estimates prepared by division engineers and writes specifications needed for particular cases, as well as keeps the standard specifications for the various types of roads revised in accordance with conditions to be met. At times the road engineer makes progress and final inspections of construction work and such other inspections preliminary to construction as seem advisable. The office checks payment estimates authorized by division engineers and handles all work in connection with proposed county road systems in the way of working up preliminary charts, directing the traffic census, making approximate estimates and preparing several tentative road systems for the county. For all road work done by counties to be maintained by the State, the plans, specifications and estimates are examined by the road engineer's office and reports made accordingly. The road engineer has two assistants, one acting in his conjunction when present and in his

stead when absent from the office, the other acting as office engineer in immediate charge of the engineering work involved.

Table I shows the cost of all State aid surveys to January 31, 1915. A description of how this work is handled may be of interest.

In nearly all cases the bureau has taken the work of making surveys into its own hands, furnishing two men for the party and calling upon the county superintendent of highways to furnish the others with the necessary transportation and supplies. The two men being thoroughly familiar with the practice, the desired information is gotten in the survey.

At first one might consider this to be a rather costly method of organizing and conducting a survey party, since for each county there is a new organization, the men furnished by the county being more or less unfamiliar with survey work. However, inasmuch as the average length of the surveys has been only two or three miles, and there is nearly always lost considerable time in moving from one job to another, this method of handling the work is really more satisfactory than the method of transporting from place to place a complete survey party.

In looking over the table it will be noted that the costs of surveys vary greatly, as would be expected because of the different conditions. Many of the first surveys made were costly because of the lengths being so short and more time really being used in the work preliminary to starting the survey than in making the survey itself. In the earlier surveys a condition encountered was getting the help furnished by county superintendents of highways familiar with the work. As the practice went on, however, these men became more familiar with the bureau's practice and were ready to proceed with the work as soon as the men arrived at the site; in fact, in a few cases surveys were made by the county superintendent without the assistance of the bureau men. Weather conditions also have affected the cost of surveys to some extent, for the usual practice has been to make them during the winter months after the men are released from construction work. Topographic features and the lengths of the surveys have played an important part in the final cost records.

Due to the intermittent system of getting out the first road plans, there is very little cost data available on this phase of the work, for the plans were prepared in such a manner and under such conditions that the road work and bridge work were not kept separate. With the division engineers handling the work it is intended to have records kept on the cost of making plans and estimates, and by having the men who had charge of the surveys make up the plans, it is expected that the more intimate knowledge of local conditions will bring about many economies and result in more satisfactory grade lines being established.

As a rule an engineer inspector is furnished for each road under construction, his duties being to see that the work progresses according to the provisions of the contract and to do the necessary surveying work to this end. Since these men are daily residents on the job, it will be seen that the cost of inspection varies with the rate of progress made by contractors. Even for jobs of the same size and character the cost of inspecting State aid roads has varied greatly, due to the various rates of progress made by the contractors.

TABLE I—COST OF STATE AID ROAD SURVEYS

County.	Route.	Beginning.	Ending.	Date of survey.
Adams	5	Sta. 0+00 east city limits of Quincy	Sta. 107+00	4-9,10-14
	5	Sta. 107	Sta. 252+50	1-10-16
	5	Sta. 252+50	Sta. 283+08	12-15-16
Alexander	1	Sta. 0+00 north line Sec. 1, Unity Twp.	Sta. 243+00	11-11-14
	1	Sta. 242+82 north city limits of Tamms	Sta. 459+47	5-31-16
Bond	7	Sta. 0+00 at end of concrete road	Sta. 53+00	2-11-14
	3	Sta. 0+00 end of brick pavement	Sta. 531+87.4	11-15-15
	2	Sta. 0+00 end of macadam road	Sta. 54+00	12-20-16
Boone	1	Sta. 0+00 section corner of Sections 1 and 12, Belvidere Twp. and sections 6 and 7 Bonus Twp.	Sta. 110+00	4-20,21,22-14
	1	Sta. 110+44	Sta. 120+00	6-23-15
	1	Sta. 120+00	Sta. 158+90	8-14-15
	3	Sta. 0 south end of bridge over Coon Creek	Sta. 27+00	.....
	5	Sta. 0+00 1¾ mi. W. of S. E. corner of N. E. ¼ Sec. 27, T. 43 N., R. 3 E.	Sta. 80+00	4-6-16
Brown	1	Sta. 0+00 north city limits of Mt. Sterling	Sta. 105+91	3-3-16
	2	Sta. 0+00 east city limits of Mt. Sterling	Sta. 106+00	3-7-16
	5 & 4	Sta. 0+00 south city limits of Mt. Sterling	Sta. 106+00	3-1-16
	7	Sta. 0+00 west city limits of Mt. Sterling	Sta. 106+00	3-3-16
Bureau	3	Sta. 0 east city limits of Princeton	Sta. 58+00	1-14-15
	1	Sta. 0 west city limits of Princeton	Sta. 56+00	1-15-15
	7	Sta. 0 west city limits of Princeton	Sta. 55+53.4	1-18-15
	4	Sta. 0 south city limits of Princeton	Sta. 62+93.1 (822 ft. prelim.)	1-19-15
	4	Sta. 0+00 north city limits of Tiskilwa	Sta. 32+60	12-29-15
	4	Sta. 32+60	Sta. 53+00	12-8-16
	3	Sta. 0+00 Sec. cor. Secs. 15, 16, 21 and 22, Hall Twp.	Sta. 36+00	12-30-15
	2	Sta. 0+00 Sec. 8, Berlin Twp.	Sta. 31+00	1-3-16
	1	Sta. 0+00 south city limits of Ohio	Sta. 37+00	1-4-16
	1	Sta. 37+00	Sta. 53+00	12-11-16
	6	Sta. 0+00 east limits of Neponset	Sta. 54+00	1-7-16
	9	Sta. 0+00 ½ mile (nearly) northwesterly from Greenville-Manlius Twp. line	Sta. 30+00	1-6-15
	9	Sta. 30+00	Sta. 53+00	12-7-16
	2	Sta. 1+00 city limits of Princeton	Sta. 56+00	12-12-16
	3A	Sta. 0+00 south city limits of Ladd	Sta. 30+00	12-9-16
Calhoun	1	Sta. 47+20 on twp. line	Sta. 87+00	3-17-15
	1	Sta. 87+00	Sta. 109+00	9-6-15
		Sta. 109+00	Sta. 128+00	8-16-15
Carroll	2	Sta. 0+00 at south quarter corner of Sec. 7	Sta. 84+00	5-17-14
		Sta. 88+50	Sta. 224+00	6-5-15
	8	Sta. 0+00 at center of south half of Sec. 12, Mt. Carroll Twp.	Sta. 107+00	12-15-16
Cass	5	Sta. 0 east city limits of Beardstown	Sta. 123+00, (Sta. 0+00 to Sta. 69+50.4) prelim	4-7-14
	7	Sta. 27+00	Sta. 51+00	5-21-15
	8	Sta. 0+00 at intersection of routes 5 and 8	Sta. 59+00	12-3-15
	5	Sta. 47+00	Sta. 69+50	8- -15
	5	Sta. 0+00 east city limits of Beardstown	Sta. 47+00	2-21-16
	7	Sta. 0+00 east city limits of Beardstown	Sta. 54+75	9-2-15
Champaign	3	Sta. 0 east city limits of Urbana	Sta. 93+00	3-23-14
	5	Sta. 0 south city limits of Champaign	Sta. 93+00	3-24-14
	7	Sta. 0 north city limits of Champaign	Sta. 93+00	3-25-14
	1	Sta. 00 intersection routes 1 and 7	Sta. 377	3-3-16
	2	Sta. 0+00 north city limits of Urbana	Sta. 368	2-24-16
	7-B	Sta. 91 400 ft. south of end of Section A	Sta. 460	1-25-16
	4	Sta. 0+00 south city limits of Urbana	Sta. 376	2-16-16
	5	Sta. 93 (1,490 ft. south of end of Sec. B)	Sta. 401+77	2-10-16
	7	Sta. 93	Sta. 241+50	3-10-16
		Sta. 241+50	Sta. 304	3-14-16
	6	Sta. 0 west city limits of Champaign	Sta. 72+00	12-18-16
Christian	12	Sta. 0+00 west city limits of Pana	Sta. 100+00	12-22-15
	9	Sta. 0+00 at east city limits of Taylorville	Sta. 151+00	.....

DECEMBER 1, 1913, TO DECEMBER 31, 1916.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day.	Total cost of survey.	Average cost per mile.	Remarks.
R. L. Bell	4		Level	2.03	1.015	$ 53	$26 10	
C. C. Hinsdale	5	Cold and clear	Rough	2.8	0.2857	135	48 20	
C. S. McArdle	5	Clear and cold	..do	0.60	0.600	34	56 70	
M. W. Watson	4	Cold	..do	4.60	0.68	113	24 60	
R. P. Devine	4	Hot	Very rough	4.10	0.68	101	24 60	
R. L. Bell	5	Cold	Rough	1.00	1.00	25	25.00	
C. I. Burggraf	4	Cold and stormy	Level	10.07	0.671	281	27.90	
..do	4	Cold and snow	Rolling	1.02	0.408	50	49.35	
C. M. Hathaway	5	Fair	Rough	2.08	0.693	75	36 00	
L. Schwartz				1.771		*	*	
..do				0.737		*	*	
..do				0.512		*	*	
H. C. Peterson	5	Fair	Rolling	1.52	0.76	54	35 70	
W. F. Kruckeberg	5	Cold	Rough	2.0	0.6667	42	21 00	
G. E. Schopmeyer	5	..do	..do	2.0	0.6667	45	22 50	
W. F. Kruckeberg	5	..do	Level	2.0	0.6667	40	20 00	
G. E. Schopmeyer	5	..do	..do	2.0	0.6667	43	21 50	
H. E. Surman	5		..do	1.10	1.10	33	30 00	
..do	5		..do	1.06	1.06	33	31 10	
..do	5		Rolling	1.05	1.05	33	31 40	
..do	5		Level	1.192	1.192	33	27 70	
S. C. Campbell	5	Cold and snow	..do	0.62	0.62	24	38 10	
R. E. Thomas	4	Snow and rain	..do	0.39	0.52	15	38 50	
S. C. Campbell	6	Cold and fair	..do	0.68	0.68	21	30 90	
..do	6	Cold	..do	0.59	0.59	49	83 00	
..do	6	Cold and fair	Rough	0.70	0.70	23	32 90	
R. E. Thomas	4	Fair	Level	0.30	0.41	17	41 75	
S. C. Campbell	6	Cold and clear	Rolling	1.02	1.02	27	26 40	
..do	6	Cold	..do	0.57	0.57	32	56 20	
R. E. Thomas	4	Fair	..do	0.44	0.59	16	36 40	
..do	4	Snow and rain	Level	1.06	0.85	28	26 40	
..do	4	Cold and fair	..do	0.57	0.76	17	29 70	
M. W. Watson	5		Rough	1.64	0.82	40	24 30	
J. A. Early	4	Rain	..do	0.42	0.42	11	26 20	
S. F. Wilson	4			0.36	0.36	23	64 00	
C. M. Hathaway	5		..do	1.59	1.06	59	37 10	
S. C. Campbell	5			2.57	1.285	43	16 70	
R. E. Thomas	5	Cold and snowy	Rolling	2.03	0.69	47	23 15	
R. L. Bell	5		Level	2.33	2.33	43	18 50	
John Goodell				0.455		*	*	(1)
H. B. Emery			Level	1.116		30	26.88	
John Goodell				0.426		*	*	
C. S. McArdle	4	Cold		0.89	0.600	22	24.70	
John Goodell				1.035		*	*	(1)
F. Tarrant	6		Rough	1.76	1.76	39	22.15	
..do	6		..do	1.76	1.76	39	22.15	
..do	6		..do	1.76	1.76	39	22.15	
F. C. Feutz	4	Snow	Level	7.15	1.19	119	16.75	
..do	4	Muddy	..do	6.96	1.16	107	15.40	
..do	4	..do	..do	6.98	1.074	129	18.50	
..do	4	..do	..do	7.13	1.097	129	18.10	
..do	4	Snow	..do	5.85	1.30	99	16.80	
..do	4	..do	Rough	2.81	1.12	52	18.50	
..do	4			1.18	0.56	42	36.00	
Geo. H. Baker	5	Cold	Level	1.36	0.91	23	17.30	
G. L. Judson	5		Rolling	1.895	0.947	60	31.65	
H. B. Emery	5		..do	2.860	0.953	113	39.50	

* No cost given. [1] Made by county.

TABLE I—

County.	Route.	Beginning.	Ending.	Date of survey.
Christian....	9	Sta. 0+00 east city limits of Taylorville	Sta. 263+00	1- -16
	15	Sta. 0+00 south city limits of Taylorville	Sta. 347+00	1-10-16
	12	Sta. 0+00 west city limits of Pana	Sta. 248+39	1-8-16
	23	Sta. 248+39.5 beginning of route 23	Sta. 484+10	1-18-16
Clark.....	1	Sta. 0 east city limits of Martins	Sta. 67+00	3-13-14
		Sta. 67+00	Sta. 200+00	11-16-15
Clay.....	5	Sta. 0+00 north city limits of Clay City	Sta. 62+00	5-28-14
	5	Sta. 62+70	Sta. 96+00	2-19-16
	4	Sta. 0+00 west city limits of Flora	Sta. 145+00	6-29-16
Clinton.....	11	Sta. 0+00 at west city limits of Carlyle	Sta. 72+00	1-20-15
	3	Sta. 0 east city limits of Carlyle	Sta. 62+00	5-29-14
	11	Sta. 0+00 east city limits of Breese	Sta. 200+00	3-2-14
	7	Sta. 0+00 south city limits of Breese	Sta. 180+93.5	12-3-15
	9	Sta. 0+00 south city limits of Trenton	Sta. 227+82	12-9-15
	4	Sta. 0+00 south from south right of way line of Southern R. R. at Hoffmann	Sta. 12+55	8-21-16
Coles.....	15 & 8	Sta. 0 intersection of Charleston road with east city limits, Mattoon	Sta. 156+00	2-11-14 12-13-15
	8	Sta. 156	Sta. 221+00	12-11-16
Cook.....	32	Sta. 0+00 at south city limits of Riverdale	Sta. 26+23.2	4-30-14
	38	Sta. 0+00 at south city limits of Harvey	Sta. 9+78.8 2,850 ft. of prelim	4-28,29-14
	3	Sta. 0 city limits of Niles	Sta. 266+00	4-11-14
	3	Check levels		
	29	Sta. 0 north city limits of Blue Island	Sta. 282+61.5, Sta. 22.9+68.8 to Sta. 256+12.8 preliminary	4-18-14
	15	Sta. 0 west city limits of Forest Park, 17,837 ft. prelim. included	Sta. 265+05.8	5-5-14
	19	Sta. 0+00 at west city limits of Chicago	Sta. 162+35	5-6-14
		Sta. 254+00	Sta. 360+00	6-30-14
	32	Sta. 0+00 south city limits of Riverdale	Sta. 77+51	1-6-16
	3	Sta. 0+00 north city limits of Chicago	Sta. 83+19 north limits of Niles	
		Sta. 212+00 north end of Cook County	Sta. 355+00 one-eighth mile north of Wheeling	1-19,22-16
	32	Sta. 0+00 147th St., Harvey	Sta. 25+57.7 north limits of Harvey	5-5-16
	29	Sta. 0+00 south city limits of Blue Island	Sta. 60+98.8 north end of Cook E	2-2-16
	29	Sta. 0+00 north city limits of Hazelcrest	Sta. 26+34 south limits of Hazelcrest	1-27-16
		Sta. 0+00 north city limits of Homewood	Sta. 60+91.3 south limits of Homewood	2-3-16
	38	Sta. 0+00 north city limits of Homewood	Sta. 6+34.5 intersects with Western Ave	1-28-16
	15	Sta. 0+00 east city limits of Maywood	Sta. 80+17.6 west limits of Broadview	
		Sta. 0+00 east city limits of Hillside	Sta. 73+13.9 west limits of Hillside	1-15,17-16
	29	Sta. 0+00 south city limits of Chicago Heights	Sta. 79+90 south boundary of Cook County	8-4,7-16
	15	Sta. 0+00 end of concrete road east of I. C. R. R	Sta. 9+19.7 concrete road west of I. C. R. R	8-15-16
Crawford....	3	Sta. 0+00 Robinson-Lamotte Twp. line	Sta. 180+48.8	2-5-14
	6	Sta. 0+00 southernly intersection with route 5	Sta. 53+00	2-10-14
		Sta. 48+00	Sta. 54+75	11-26-15
	5	Sta. 0+00=Sta. 0+00 on route 6	Sta. 58+50	11-24-15
Cumberland.	1	Sta. 0+00 east city limits Neoga	Sta. 162	12-13-16
DeKalb.....	1	Sta. 0 north city limits of DeKalb	Sta. 184+00, Sta. 0+00 to Sta. 123+80 prelim	4-6,7,9-14

Continued.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day.	Total cost of survey.	Average cost per mile.	Remarks.
H. B. Emery	5	Cold	Level	5.00	0.8333	$113	$22.60	
C. P. Pritzlaff	5	..do	..do	6.60	0.8250	159	24.10	
G. L. Judson	5	Very cold	..do	4.70	0.671	136	28.70	
..do	5	..do	..do	4.50	0.691	130	28.90	
R. L. Bell	5		..do	1.27	1.27	47	37.00	
F. C. Feutz	5		..do	2.52	0.84	50	19.80	
M. W. Watson	5		..do	1.175	0.588	35	29.80	
R. P. Devine	4	Cold—rain	..do	0.63	0.315	32	51.00	
..do	5	Fair	Rough	2.74	0.68	71	25.95	
C. M. Slaymaker	5	Snow	Level	1.364	0.455	72	52.80	
M. W. Watson	5		Rough	1.175	0.392	64	54.50	
R. L. Bell	7		Level	3.79	1.895	75	19.80	
C. I. Burggraf	5		..do	3.426	1.00	74	21.50	
..do	4	Rain	..do	4.314	0.72	151	34.95	
J. A. Davenport	4		..do	0.237	0.237	16	67.50	
R. L. Bell	5		..do	2.95	0.983	50	16.95	
F. C. Feutz	3							
P. F. Jervis	5	Snow—muddy	..do	1.23	0.82	44	36.00	
H. B. Bushnell	5		..do	0.497	0.497	31	62.40	
..do	6		..do	1.89	0.945	56	29.60	
..do	5		..do	5.04	0.84	210	41.70	
.....	..		.....					
H. B. Bushnell	5		Level	5.35	0.669	206	38.50	
..do	5		..do	5.02	1.255	125	24.90	
..do	5	Rain	..do	3.07	0.384	152	49.50	
Flauger	..		.....	2.01	.....	*	*	(1)
L. Schwartz	3	Cold and stormy	Level	1.47	0.49	49	33.20	
..do	2	Cold and rain	Rolling	4.29	0.86	120	28.00	
H. C. Peterson	5	Fair	Level	0.48	0.32	34	82.30	
L. Schwartz	3	Cold	..do	1.15	0.38	50	43.90	
..do	3	Cold and snow	Rolling	1.77	0.59	51	28.60	
..do								
..do	3	Very cold	Level and rolling	2.90	0.97	70	24.00	
C. R. Dooling	4	Hot	Fairly level	1.48	0.30	64	43.60	
L. Schwartz	3	Fair	..do	0.17	0.34	9	80.30	
F. Tarrant	5		Rough	3.42	0.855	75	21.90	
R. L. Bell	5		..do	1.00	1.00	37	32.80	
F. C. Feutz				0.128	0.128			
..do	5		Rolling	1.090	1.090	31	28.50	
P. F. Jervis	4	Snow and cold	Level	3.07	1.023	73	23.80	
H. B. Bushnell	6	Fair	..do	3.49	1.16	86	24.60	

* No cost given. [1] Made by county.

TABLE I—

County.	Route.	Beginning.	Ending.	Date of survey.
DeKalb	1	Sta. 0 south city limits of DeKalb	Sta. 265+00, Sta. 0+00 to Sta. 105+00 prelim.	4-8,10,11,13-14
	4	Sta. 0 west city limits of Malta	Sta. 23+00	4-14-14
		Sta. 23+00	Sta. 76+00	4-15-14
	7	Sta. 0 a point 43½ ft. south of Sta. 264+60 route 7	Sta. 52+95	4-28-15
				12-6-15
	1	Sta. 0+00 east end of DeKalb A	Sta. 48+08 with limits of Sycamore	12-1-16
	9	Sta. 0+00 south city limits of Waterman	Sta. 80+00	12-4,5-16
DeWitt	1	Sta. 0+00 north city limits of Clinton	Sta. 201+68	9-11-16
	2	Sta. 0+00 south city limits of Clinton	Sta. 73+59	11-17-16
	6	Sta. 0+00 east city limits of Clinton	Sta. 95+29	11-16-16
Douglas	11	Sta. 0 south city limits of Hindsboro	Sta. 26+40	7-20-14
	3	Sta. 0 southeast corner city limits of Tuscola	Sta. 133+00	6-14-14
	1	Sta. 0+00 northwest city limits of Tuscola	Sta. 30	1-22-16
	3	Sta. 0 west city limits of Tuscola	Sta. 329	1-20-16
		Sta. 329	Sta. 478	1-28-16
	9	Sta. 0+00 (½ mi. north of northwest limits of Arcola)	Sta. 52	2-4-16
DuPage	1	Sta. 0+00 at intersection with route 2	Sta. 255+00, Sta. 0+00 to Sta. 95+85.5 prelim.	4-1-14
	1	Sta. 0 same point as Sta. 265+05.8	Sta. 22+26.5	4-22-15
	1	Sta. 255+00 west end of DuPage A	Sta. 426+00 east limits of Wheaton	1-5,8-16
	1	Sta. 0+00 east end of DuPage A	Sta. 53+00	12-30-16
Edgar	2	Sta. 0 east city limits of Bath	Sta. 157+00, Sta. 0+00 to Sta. 103+32.7 prelim.	3-30-14
	6	Sta. 0+00 east line of Grandview Twp.	Sta. 245+00, Sta. 0+00 to Sta. 19+66.8 prelim.	4-2-14
	1	Sta. 0+00 north side Sec. 25 Paris Twp.	Sta. 12+00	.....
	4	Sta. 53+00, Sta. 0+00, north boundary Symmes Twp.	Sta. 130	3-30-16
	7	Sta. 53+00, Sta. 0+00, west boundary Paris Twp.	Sta. 122	3-29-16
Edwards	1	Sta. 0 north city limits of Albion	Sta. 53+00	2-3-15
	3	Sta. 0+00 east city limits of Albion	Sta. 48+00	1-21-16
	5	Sta. 0+00 west city limits of Albion	Sta. 27+00	11-29-16
Effingham	1	Sta. 0+00	Sta. 80+00	2-9-15
	7	Sta. 0+00 south city limits of Effingham	Sta. 84+17.6	2-8-15
	5	Sta. 0+00 south line east and west road through Elliotstown	Sta. 206+00	2-17-16
	7	Sta. 0+00 Douglas-Watson Twp. line	Sta. 268+00	2-9-16
	13	Sta. 0+00 south village limits of Shumway	Sta. 203+51	2-15-16
Fayette	6	Sta. 0 east city limits of Vandalia	Sta. 174+00, (9,990 ft. preliminary)	6-2-14
	10	Sta. 0 south city limits of Vandalia	Sta. 53+00	6-2-14
	6	Sta. 0+00 end of concrete road	Sta. 308+00	1-4-16
	11	Sta. 0+00 west city limits of Vandalia	Sta. 299+00	1-15-16
	1	Sta. 0+00 north city limits of Vandalia	Sta. 321+00	2-26-16
	9	Sta. 0+00 at Old National Trail road	Sta. 196+00	3-10-16
	10	Sta. 0 south city limits of Vandalia	Sta. 152+87.4	7-7-16
Ford	1	Sta. 0+00 south village limits of Roberts	Sta. 80+00	3-26-15
	5	Sta. 0+00 (2½ mi. east of Paxton)	Sta. 184+00 (runs east)	12-16-15
	5	Sta. 0+00 (6½ mi. west of Paxton)	Sta. 84+00 (runs west)	12-12-15
Franklin	1A	Sta. 0+00 east city limits of Whittington	Sta. 39+20 (to Kents St.)	3-10-14
	1	Sta. 0 intersection of routes 1 and 1A	Sta. 79+16 city limits, Ewing	3-11-14
		Sta. 15+00 (resurvey) to Sta. 26+00	Sta. 39+00 to Sta. 55+00 preliminary	5-4-15
	4	Sta. 0+00 east city limits of Benton	Sta. 83+00	7-3-16
Fulton	3	Sta. 37+66 (3,766 ft. north of Canton)	Sta. 87+08	8-29-14
	16	Sta. 47+56.5 (4,756.5 ft. west of Canton)	Sta. 114+00	8-31-14
	2	Sta. 39+50 (3,920 ft. west of Canton)	Sta. 85+00	9-2-14
	4	Sta. 66+03	Sta. 92+60	9-3-14

Continued.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day	Total cost of survey.	Average cost per mile.	Remarks.
C. M. Hathaway	5	Fair	Level	5.02	1.25	$117	$23.30	
..do	5	..do	..do	1.44	0.72	53	36.80	
L. Schwartz	..			1.003	0.501	25	25.00	
A. F. Keehner	5	Rain and cool	Rolling	0.91	0.45	53	58.50	
..do	5	Fair and cool	..do	1.52	0.76	53	35.00	
K. N. Evans	5	Warm	Level	3.80	0.760	95	25.00	
..do	5	..do	..do	1.39	0.556	33	23.80	
..do	5	..do	..do	1.80	0.720	43	23.90	
R. L. Bell	4		..do	0.50	0.50	14	28.00	
J. E. Huber	5		..do	2.52	1.12	52	20.60	
F. C. Feutz	4	Cold	..do	0.57	1.14	7	13.40	
..do	4	Cold and snow	..do	6.24	1.38	114	18.30	
P. F. Jervis	4	Rain and mud		2.82	1.41	58	20.60	
..do	4	Muddy	..do	1.00	1.00	17	17.00	
H. B. Bushnell	5	Fair	..do	4.83	1.61	95	19.70	
O. B. Kercher	..			0.422	.....	*	*	
L. Schwartz	5	Cold and snow	Rolling	3.14	0.79	86	27.50	
L. P. Scott	5	Cold and clear	Swamp	1.00	0.75	55	55.00	
R. L. Bell	5	Rainy	Level	2.97	1.485	61	20.50	
..do	5		..do	4.64	2.32	76	16.30	
..do	..			0.227	.....	*	*	
F. C. Feutz	4	Fair	Rough	1.45	1.45	11	7.75	
..do	5	..do	Level	1.30	1.30	11	8.70	
J. E. Huber	5		Rough	1.005	1.005	40	39.80	
M. J. Fleming	5	Wet and muddy	..do	0.91	0.91	21	22.60	
..do	5	Fair	..do	0.51	0.51	25	49.00	
J. E. Huber	5		Level	1.515	0.758	42	27.70	
..do	5		..do	1.594	0.797	42	26.35	
C. I. Bruggraf	5	Muddy	Rough	3.90	0.65	152	39.00	
..do	8	Clear and cold	Rolling	5.08	1.02	136	26.75	
..do	9	..do	..do	3.85	1.285	67	17.30	
M. W. Watson	5		Level	3.30	1.10	43	13.00	
..do	4		Rolling	1.00	0.50	25	25.00	
C. I. Bruggraf	4		..do	5.83	0.73	162	27.75	
..do	4	Cold and stormy	..do	5.66	0.47	219	38.60	
..do	4	Muddy—snow	..do	6.08	0.675	203	33.30	
..do	4	Fair and warm	Level	3.71	0.93	70	18.85	
..do	5		Rolling	2.89	0.82	73	25.25	
A. H. Hunter	..			1.515	.....	*	*	
E. B. Blough	4	Snow	Level	3.49	.58	98	28.10	
..do	4	..do	..do	1.59	.53	41	25.95	
R. L. Bell	6		..do	0.74	0.74	35	47.30	
..do	6		..do	1.50	1.25	47	31.30	
J. E. Huber	2			0.21	0.21	15	71.50	
R. P. Devine	5	Hot and fair	Rough	1.57	0.52	54	34.50	
E. F. Motsinger	4		Level	0.936	.....	*	*	(1)
..do	4		..do	1.258	0.84	*	*	(1)
..do	4		..do	0.862	0.862	*	*	(1)
..do	4		..do	0.503	1.006	*	*	(1)

* No cost given. [1] Made by county.

TABLE I—

County.	Route.	Beginning.	Ending.	Date of survey.
Fulton	5	Sta. 13+12 end of brick road, 1,312 ft. east of Canton	Sta. 60+00	9-4-14
	4	Sta. 0+00 Canton-Buckheart Twp line	Sta. 53+00	11-13-16
	6	Sta. 0+00 city limits of Monterey	Sta. 110+00	11-14-16
	11	Sta. 0+00 city limits of Duncan Mills	Sta. 80+00	11-16-16
	14	Sta. 0+00 north end Elrod bridge	Sta. 36+00	11-17-16
	15	Sta. 0+00 1,200 ft. east of west city limits of Smithfield	Sta. 139+00	11-20-16
	16	Sta. 0+00 east limits of Manley	Sta. 95+00	11-29-16
Greene	1	Sta. 0+00 within city of Carrolton	Sta. 14+76.3, Sta. 285+00	4-15-16
	3	Sta. 0+00 north city limits of Greenfield	Sta. 253+00	4-26-16
	1	Sta. 0+00 north city limits of Whitehall	Sta. 104+48.6	4-21-16
		Sta. 0+00 north city limits of Roodhouse	Sta. 119+50.2	
Grundy	2	Sta. 0 south city limits of Morris	Sta. 179+90	6-25-14
Hancock	9	Sta. 0+00 west city limits of Augusta	Sta. 267+18	2-1-16
	14	Sta. 0+00 west city limits of Carthage	Sta. 264+66	2- -16
	4	Sta. 0+00 west from McDonough Co. line	Sta. 321+12	2- -16
	4A	Sta. 240+43 beginning of route No. 4A	Sta. 323+29	2- -16
	1	Sta. 0+00 south city limits of Dallas City	Sta. 214+65	2- -16
	1-C	Sta. 0+00 (Sta. 214+65 on route No. 1)	Sta. 28+63	2- -16
	14	Sta. 264+68	Sta. 364+00	12-19-16
Henderson	2	Sta. east city limits of Oquawka	Sta. 42+37.8	5-2-16
Henry	1	Sta. 0 north city limits of Cambridge	Sta. 52+71.5	5-19-14
		Sta. 52+71.5	Sta. 122+00	1-12-15
	6	Sta. 0+00 north city limits of Kewanee	Sta. 321+80	12-23-15 1-17-16
	2	Sta. 4+30	Sta. 16+18.8	7-6-16
Iroquois	7	Sta. 0 west city limits of Watseka	Sta. 185+00	3-18-14
	7	Sta. 0 south city limits of Watseka	Sta. 238+36, Sta. 0+00 to Sta. 106+30 preliminary	3-20-14
	1	Sta. 0 2¾ mi. north of city limits of Watseka	Sta. 120+85.5	7-30-15
	14	Sta. 0+00=Sta. 106+30 route 7	Sta. 110+00	7-30-15
	14	Sta. 110+00	Sta. 229+00	7-12-16
	7	Sta. 185+00	Sta. 215+00	2-9-15
	1	Sta. 120+85.5	Sta. 265+66	7-10-16
Jackson	4	Sta. 0+00 southwest city limits Murphysboro	Sta. 38+81	6-20-14
	2	Sta. 0, route 2=Sta. 38+81 on route 4	Sta. 17+00	6-20-14
	3	Sta. 0+00 in N. ½ Sec. 9, T. 9 S., R. 1 W., 3 P. M	Sta. 53+00	7-28-16
	2	Sta. 0+00 in N. E. ¼ Sec. 22, T. 9 S., R. 1 W., 3. P. M	Sta. 85+00	7-28-16
	11	Sta. 0+00 south of cor. Secs. 3, 4, 9 and 10, Carbondale Twp	Sta. 47+00	7-29-16
	13	Sta. 0+00 east of cor. Sec. 17, 18, 19, 20, Carbondale Twp	Sta. 30+00	7-25-16
Jasper	1	Sta. 0+00 north city limits of Newton	Sta. 21+34.9	12-20-15
	2	Sta. 0+00 intersection of routes 1 and 2	Sta. 39	12-23-15
	5			
	6			
	9			
Jefferson	3	Sta. 0 east city limits of Mt. Vernon	Sta. 80+00	5-21-14
	8	Sta. 0 east Twp. line of Shiloh Twp	Sta. 340+00	1-13-16
Jersey	2	Sta. 0 west city limits of Jerseyville	Sta. 177+00 (13,000 ft. prelim.)	6-6-14
	6	Sta. 0+00 south city limits of Jerseyville	Sta. 172+45	3-28-16
JoDaviess	1	Sta. 0 east city limits of Elizabeth	Sta. 40+00	1-21-15
	1	Sta. 40+00	Sta. 95+00	12-8-15
	1	Sta. 0 west city limits of Galena	Sta. 40+00	1-22-15
	1	Sta. 40+00	Sta. 93+00	1-23-15
	1	Sta. 95+00	Sta. 107+00	12-8-16
	1	Sta. 93+00 (Galena west)	Sta. 107+00	11-28-16

Continued.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day.	Total cost of survey.	Average cost per mile.	Remarks.
E. F. Motsinger	4			0.888	0.888	*	*	(1)
L. A. Doan	3	Cold	Rolling	1.000	1.000	$ 24	$24.00	
..do	4	..do	Rough	2.08	1.04	38	18.35	
..do	3	Fair	..do	1.52	1.52	28	24.35	
..do	4	..do	Level	0.68	0.68	20	29.60	
..do	3	Fair and rain	Rough	2.63	0.88	68	26.15	
..do	3	Fair	Rolling	1.80	0.90	26	14.35	
C. I. Burggraf	5	Clear	..do	5.68	0.668	188	33.15	
..do	4	..do	..do	4.79	0.684	122	25.55	
..do	5	Cold and rain	Level	4.24	0.652	121	28.50	
L. Schwartz	5		..do	3.405	1.135	58	17.03	
H. B. Emery	6	Snow on ground	..do	5.00	1.110	176	35.20	
..do	6	..do	..do	5.00	1.110	118	23.60	
..do	6	..do	..do	5.08	1.110	196	32.20	
..do	6	..do	..do	1.60	1.200	51	31.80	
..do	6	..do	..do	4.00	0.500	162	40.50	
..do	6	..do	..do	0.54	0.540	20	37.00	
C. S. McArdle	5	Cold, snow	..do	1.88	0.940	21	11.20	
O. F. Goeke	5	Rain	Rolling	0.80	0.80	21	25.20	
C. M. Hathaway	5		Level	1.00	0.667	49	49.00	
H. E. Surman	5			1.31	0.874	49	37.40	
W. J. Griffin	6	Rain and cold	Hilly	6.10	0.50	297	48.50	
O. F. Goeke	4	Fair	Level	0.22	0.44	7	31.15	
R. L. Bell	6		Rough	3.50	1.75	73	20.85	
..do	6		..do	4.52	2.26	48	10.60	
F. C. Feutz	5		Level	2.290	0.763	36	15.70	
..do	5		..do	2.083	0.694	36	17.30	
..do	4	Fair	..do	2.255	1.128	23	10.20	
R. L. Bell	4		..do	0.568	0.568	17	29.90	
F. C. Feutz	4	Fair	Level	2.75	1.37	32	11.70	
J. E. Huber	5		..do	0.735	0.245	43	58.50	
..do	5		Rolling	0.322	0.080	28	87.00	
R. P. Devine	5	Hot and fair	..do	1.00	0.50	31	31.00	
..do	5	..do	Rough	1.61	0.54	45	27.70	
..do	5	..do	Level	0.90	0.90	21	23.50	
..do	5	..do	Rough	0.57	0.57	19	33.00	
F. C. Feutz	5	Rainy	Level	0.405	.81	9	23.00	
..do	5	..do	..do	0.740	1.48	9	12.75	
M. W. Watson	4		Level	1.515	0.505	85	56.10	
M. J. Fleming	5	Cold and stormy	Rough	6.45	0.92	111	17.10	
M. W. Watson			Level	3.35	0.837	38	11.35	
O. B. Kercher	5		Rolling	3.26	0.60	118	36.20	
H. E. Surman	5		Rough	0.758	0.758	31	40.90	
W. J. Griffin	4		..do	1.04	1.04	34	32.70	
H. E. Surman	5		Level	0.758	0.758	25	33.00	
W. J. Griffin	5		Rough	1.005	0.503	18	17.90	
C. W. Ross	3		Rolling	0.23	0.23	11	47.50	
..do	3		..do	0.265	0.265	10	37.60	

* No cost given. [1] Made by county.

TABLE I—

County.	Route.	Beginning.	Ending.	Date of survey.
Kane	1	Sta. 0 city limits of Aurora	Sta. 306+80 (includes 115 Sta. prelim.)	3-23-14
	1	Sta. 306+80 north city limits of Batavia	Sta. 387+37	3-23-14
	1	Sta. 0+00		4-21-15
	1 & 12			
		Sta. 0+00		7-21-15
Kankakee	1G	Sta. 0 intersection of routes 1 and 1-G	Sta. 142+10	
	1	Sta. 0+00 at northeast cor. Ganeer Twp	Sta. 53+10.5	6-17-15
	15	Sta. 0+00 north city limits of Kankakee	Sta. 13+41	6-18-15
	1	Sta. 0+00 west city limits of Kankakee	Sta. 54+00	4-10-16
	1	Sta. 0+00 west of southeast cor. Limestone Twp	Sta. 91+00	4-12-16
Kendall	1	Sta. 0 a point on Kane and Kendall Co. line	Sta. 148+00	6-29-14 12-30-15
	1	Sta. 90+00 (resurvey)	Sta. 148+00 (north limits of Oswego)	1-3-16
Knox	1	Sta. 0+00 north city limits of Galesburg	Sta. 206+80	1-18,25-16
	1	Sta. 206+80	Sta. 537+46	1-27-16 2-11-16
	2	Sta. 0+00 at route 1 (westerly)	Sta. 53+16.6	2-9,11-16
	3	Sta. 0+00 north city limits Galesburg	Sta. 241+73	8-10-16
	10	Sta. 0+00 south east city limits Galesburg	Sta. 149+21	8-17-16
	16	Sta. 0+00 cor. of Secs. 7, 8, 17 and 18, Galesburg Twp	Sta. 52+10	8-21-16
	11	Sta. 0+00 east city limits Knoxville	Sta. 314+41	8-22-16
	11	Sta. 267+59.5 (relocation)	Sta. 286+00	8-26-16
Lake	6	Sta. 0 east city limits of Lake Villa	Sta. 170+00	3-17-14
		Sta. 170+00	Sta. 189+21.7	11-26-15
	6	Sta. 71+12.5	Sta. 125+00	11-24-16
	10	Sta. 0+00 one-eighth mile west of southeast cor. Sec. 13, Cuba Twp	Sta. 47+00	11-27-16
LaSalle	11A	Sta. 47+63.3 south end Shippingsport Bridge	Sta. 79+00	4-27,28-14
	9	Sta. 0 south city limits of North Utica	Sta. 85+10	(4-29) (5-9)-14
		Sta. 41+13 (relocation)	Sta. 59+36.2	6-21-14
	1	Sta. 0 south city limits of Earlville	Sta. 202+00 (8,900 ft. preliminary)	5-4,5,6-14
	11	Sta. 0+00	Sta. 26+00	
		Sta. 48+00	Sta. 74+00	
	11	Sta. 48+51 (49+37.8 is north end of Ill. River bridge	Sta. 133+46	
	11	Sta. 0+00 top of Dimmick Hill	Sta. 26+36	4-27-15
	5	Sta. 0+00 ½ mi. north of Streator	Sta. 60+00	3-17-16
	6-C	Sta. 0+00 south end Ill. River bridge 1 mi. south of Seneca	Sta. 70+98	3-18-16
	11	Sta. 133+46 north end Big Vermilion bridge	Sta. 294+84	4-3-16
	1	Sta. 65+00 (Sta. 0+00 is south city limits of Earlville)	Sta. 92+00	6-1-16
	14	Sta. 0+00 2 mi. north of Lostant	Sta. 107+00	5-30-16
	8	Sta. 0+00 west city limits of South Ottawa	Sta. 54+00	5-28-16
	15	Sta. 0+00 south end of Ill. River bridge at Marseilles	Sta. 59+00	11-16-16
	7	Sta. 0+00 east city limits of Streator	Sta. 53+00	11-17-16
Lawrence	2	Sta. 0+00 east county line	Sta. 80+00	11-22-15
	5	Sta. 0+00 northeast cor. Sec. 5, Bridgeport Twp	Sta. 275+00 (Sta. 0+00 to Sta. 194+90 preliminary)	5-25-14
	5	Sta. 275+00	Sta. 315	7-10-16
Lee	5	Sta. 0+00 1¼ miles southeasterly from South Dixon, Nachusa Twp. line	Sta. 197+00 (Sta. 0+00 to Sta. 65+00 preliminary)	5-11,12,13-14
	5A	Sta. 0+00 north city limits of Amboy	Sta. 105+3.0	5-19-16
	17	Sta. 0+00 east line of Palmyra Twp	Sta. 55+45	12-13-16

Continued.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day.	Total cost of survey.	Average cost per mile.	Remarks.
H. B. Bushnell	6	Wet	Thickly settled	5.81	0.815	$270	$ 36.80	
..do	6	..do	..do	1.53				
G. N. Lamb	..					*	*	(1)
	..					*	*	(1)
	..					*	*	(2)
L. Schwartz	..			2.69		*	*	
..do	..			1.006		*	*	
..do	..			0.254		*	*	
H. C. Peterson	5		Level	1.02	1.02	32	31.40	
..do	5		Rolling and sandy	1.72	0.86	57	33.20	
L. Schwartz	5		Level	2.80	0.40	138	49.30	
..do	5	Cold	Rolling	1.10	0.37	69	62.40	
W. J. Griffin	6	Rain and mud	..do	3.81	0.49	151	39.70	
..do	6	Rain and snow	..do	6.26	0.42	257	41.10	
..do	6		Level	1.02	1.02	23	22.50	
R. E. Thomas	6	Hot and fair	..do	4.58	1.15	90	19.70	
..do	6	..do	..do	2.82	1.13	54	19.05	
..do	6	..do	Rolling	0.99	0.99	25	25.25	
..do	6	..do	..do	5.96	1.50	99	16.60	
..do	5	..do	Rough—timber	0.35	0.35	18	51.40	
H. B. Bushnell	5	Cold and fair	Rough	3.22	0.805	111	34.50	
L. Schwartz	4			0.36	0.120	47	130.50	
..do	3	Cold and snow	Rolling	1.02	1.02	40	39.70	
..do	4	Warm and rain	Very hilly	0.89	0.59	55	61.20	
C. M. Hathaway	5	Fair	Very rough	0.59	0.393	38	64.40	
..do	5	..do	..do	1.61	0.644	84	52.20	
L. Schwartz	5			0.35	0.116	82	234.00	
C. M. Hathaway	5	..do	Level	3.83	1.275	82	21.40	
A. H. Hunter	..			0.493		*	*	(3)
..do	..			0.493		*	*	(4)
John Johnson	4		Rough	1.65	0.27	101	61.20	
A. H. Hunter	4		..do	0.50	0.25	38	76.00	
E. B. Blough	4		Rolling	1.14	1.14	28	24.55	
..do	4		..do	1.34	1.34	42	30.95	
P. Sinnock	4	Fair	Rolling	3.06	1.03	41	13.30	
L. A. Doan	3	..do	Level	0.51	0.51	13	25.50	
..do	3	Rainy	..do	2.03	1.01	55	27.10	
..do	4	Warm	..do	1.02	1.02	21	20.60	
A. K. Fogg	4	Fair	Rolling	1.12	1.12	16	14.50	
..do	4	Cold	Level	1.00	1.00	16	16.00	
F. C. Feutz	5		..do	1.515	1.010	35	23.10	
M. W. Watson	5		Rolling	5.31	1.77	61	11.49	
G. A. Sommerville	3	Fair	Rough	0.76	0.50	16	20.80	
C. M. Hathaway	5		Rough	3.73	1.065	103	27.60	
O. F. Goeke	5	Fair	Level	2.00	1.33	39	19.50	
R. E. Thomas	5	Cold and snow	Rolling	1.05	0.53	32	31.00	

* No cost given. [1] Made by county. [2] Algonquin Hill. [3] Known as Dimmick Hill.
[4] Shippingport Hill.

TABLE I—

County.	Route.	Beginning.	Ending.	Date of survey.
Livingston...	11	Sta. 0 south city limits of Pontiac.....	Sta. 237+00 (Sta. 0+00 to Sta. 79+95 preliminary)	3-10-14
	16	Sta. 0 intersection of routes 16 and 16-B.	Sta. 53+63.7.....	2-11-15
	16A	Sta. 0 a point on line between Livingston and LaSalle Co.....	Sta. 256+51.5 (5,273.5 ft. preliminary).....	2-15-15
	16B	Sta. 0 same point as Sta. 0 on route 16..	Sta. 107+40.....	2-24-15
	2A	Sta. 0+00 east city line of Dwight.....	Sta. 127+00.....	9-8-15
	3D, 7	Sta. 0+00 Ford Co. line.....	Sta. 864.....	12-17-15
	11	Sta. 225.....	Sta. 593.....	1-10-16
	14	Sta. 0+00 LaSalle Co. line.....	Sta. 575.....	2-1-16
	15	Sta. 0+00 (Sta. 574+84.7 on route 14)..	Sta. 26+39.....	2-14-16
	1	Sta. 0+00 intersection of routes 1 and 10	Sta. 267.....	2-15-16
	10	Sta. 0+00 west city limits of Cornell....	Sta. 210.....	2-15-16
Logan.....	3	Sta. 0+00 northeast city limits of Lincoln.....	Sta. 40+29.....	7-27-14
	13	Sta. 0+00 west city limits of Lincoln...	Sta. 52+70.....	7-26-14
	7	Sta. 0+00 south city limits of Lincoln..	Sta. 39+00.....	7-27-14
	8	Sta. 0+00 south city limits of Latham..	Sta. 40+00.....	.....
	3	Sta. 37+00.....	Sta. 146+77.....	7-8-16
	7	Sta. 57+00.....	Sta. 191+00.....	7-8-16
	2	Sta. 0+00 north city limits of Lincoln..	Sta. 105+08.....	7-13-16
	13	Sta. 37+20.....	Sta. 150+53.....	7-11-16
	11	Sta. 0+00 Southwest city limits of Lincoln.....	Sta. 106+49.....	7- -16
	7	Sta. 191+00.....	Sta. 300+00.....	12-17-16
	13	Sta. 150+53.....	Sta. 256+00.....	12- -16
	5	Sta. 0+00 east city limits of Lincoln....	Sta. 110+00.....	12-21-16
Macon.....	1	Sta. 0+00 north city limits of Decatur..	Sta. 678+70.....	1-7-16
	12	Sta. 0+00 west city limits of Decatur...	Sta. 727+34.....	1-20-16
	8	Sta. 0+00 south city limits of Macon...	Sta. 93+82.....	2-1-16
	8-B	Sta. 0+00 (Sta. 93+82.5 route No. 8)...	Sta. 30+06.....	1-25-16
	10	Sta. 0+00 west city limits of Macon....	Sta. 427+00.....	2-3-16
Macoupin ...	1	Sta. 0 west city limits of Carlinville	Sta. 140+15.....	6-9-14
	17	Sta. 0+00 north city limits of Staunton.	Sta. 251+90.5.....	3-7-16
	1	Sta. 0+00 a point on Sangamon County line.....	Sta. 605+39.....	3-7-16
Madison.....	1	Sta. 0+00 east city limits of Alton.....	Sta. 122+33.....	3-4-14
	11	Sta. 40+61 south city limits of Wood River.....	Sta. 148+00 (4,878 ft. preliminary).....	11-26-14
	10	Sta. 0+00 near Troy Road Station.....	Sta. 43+00.....	3-3-16
	8	Sta. 0+00 near Troy Road Station	Sta. 78+00.....	4-28-16
	2	Sta. 0+00 north city limits of Edwardsville.....	Sta. 35+00.....	2-29-16
Marion.....	7	Sta. 0+00 north city limits of Salem....	Sta. 53+93.....	4-7-15
	1	Sta. 0+00 south city limits of Sandoval	Sta. 200+00.....	12-22-16
Marshall.....	2	Sta. 0+00 east city limits of Lacon.....	Sta. 78+00.....	5-28-14
	2	Sta. 76+00.....	Sta. 122+00.....	2-16-15
	7	Sta. 0+00 intersection of routes 7 and 7 A.....	Sta. 79+62.....	1-16-16
	7A	Sta. 0+00 west city limits of Sparland..	Sta. 161+00.....	1-9-16
	9	Sta. 0+00 intersection of routes 7 and 9	Sta. 502+00.....	1-18-16
	1	Sta. 0+00 Hopewell-Lacon Twp. line..	Sta. 212+70.....	11-25-16
Mason.....	1	Sta. 0+00 east city limits of Havana....	Sta. 464+20.....	3-7-16
Massac.....	2	Sta. 0+00 north city limits of Metropolis	Sta. 53+70.....	3-10-16
McDonough.	1	Sta. 0+00 north city limits of Macomb..	Sta. 210.....	12-15-15
	2	Sta. 0+00 east city limits of Macomb....	Sta. 208.....	12-15-15
	4	Sta. 0+00 intersection of routes 4 and 4A.....	Sta. 213.....	12-15-15
	4A	Sta. 0+00 south city limits of Macomb..	Sta. 26+54.....	12-15-15
	5	Sta. 0+00 west city limits of Macomb..	Sta. 213.....	12-15-15
McHenry....	3	Sta. 0 northeast corporate limits of Woodstock.....	Sta. 27+00.....	7-15-14
	15	Sta. 0 west city limits of Woodstock....	Sta. 27+00.....	7-16-14
			Sta. 232+60.....	12-8-15
	8	Sta. 0 south city limits of Woodstock...	Sta. 27+00.....	7-17-14
	3	Sta. 26+10.....	Sta. 67+00.....	7-20-15
	1	Sta. 0 northwest city limits of Woodstock.....	Sta. 27+00.....	7-14-14
	11	Sta. 0+00 south city limits of Woodstock.....	Sta. 27+00.....	7-15-14

Continued.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day.	Total cost of survey.	Average cost per mile.	Remarks.
H. B. Bushnell	5	Wet and muddy	Level	4.49	1.123	150	33.40	
C. M. Hathaway	4		..do	1.015	0.677	38	37.50	
..do	4		..do	4.860	1.944	98	20.20	
..do	4		..do	2.032	1.360	27	13.30	
W. G. Giessler	..			2.405		*	*	
J. H. Grove	5	Cold and snow	Level	16.34	0.82	475	29.10	
C. R. French	5	..do	..do	6.36	0.63	240	37.80	
..do	5	Cold	..do	10.89	0.91	183	16.85	
..do	5	..do	..do	0.50	0.50	4	8.00	
..do	5		..do	5.06	0.84	83	16.40	
..do	5		..do	3.98	1.33	41	10.40	
F. Tarrant	5		..do	0.762	0.762	12	15.75	
..do	5		..do	1.00	1.00	22	22.00	
..do	4		Rolling	0.739	0.739	12	16.25	
..do	6		Level	0.758	0.758	28	36.90	
G. E. Galusha	5	Very warm	Rolling	2.08	0.6933	62	29.80	
..do	5	..do	..do	2.54	0.8467	74	29.60	
..do	5	..do	..do	2.00	1.000	46	23.00	
..do	5	..do	..do	2.15	0.830	57	26.50	
C. S. McArdle	5	..do	..do	2.00	0.500	59	29.50	
E. B. Gordon	5	Cold—snow	..do	2.06	0.6866	47	22.80	
..do	5	..do	..do	2.00	0.6667	51	25.50	
..do	5	..do	Level	2.08	0.693	58	27.90	
H. B. Emery	5	..do	..do	12.85	0.800	302	23.60	
..do	6	..do	Rolling	13.80	1.380	263	19.00	
..do	6	..do	..do	1.78	1.187	26	14.60	
..do	5	..do	..do	0.57	1.140	9	15.80	
..do	5	..do	..do	8.09	1.313	134	16.60	
M. W. Watson	..		..do	2.65	0.662	64	24.15	
O. B. Kercher	5		..do	4.77	0.68	190	40.00	
..do	4		..do	6.33	0.503	277	43.70	
R. L. Bell	6		Level	2.32	0.773	98	42.20	
M. W. Watson	5		..do	2.03	1.35	75	37.20	
B. C. McCurdy	4	Cold and snow	Rolling	0.814	0.271	45	55.30	
..do	4		..do	1.477	0.738	25	16.95	
..do	4	Cold and stormy	..do	0.66	0.331	31	46.80	
L. Schwartz	5		Level	1.020	1.020	*	*	
R. P. Devine	5	Very stormy	Rolling	3.78	0.76	87	23.10	
C. M. Hathaway	6		Rough	1.475	0.492	70	47.50	
A. H. Hunter	..		Level	0.871		*	*	
W. C. Giessler	4	Cold	Rolling	1.51	0.50	47	31.10	
..do	4	..do	..do	3.09	0.51	101	32.80	
..do	4	Cold and rain	..do	9.52	0.56	187	19.65	
A. K. Fogg	4	Fair	..do	4.03	1.34	72	17.90	
C. P. Pritzlaff	5	Cold	Level	8.78	0.840	219	25.00	
J. E. Huber	5	Cold and windy	..do	1.02	1.02	28	27.40	
W. C. Giessler	5		..do	3.98		97	24.40	
J. D. Mattison	5		..do	3.94		97	24.40	
..do	5	Cold	Rolling	4.04		97	24.40	
..do	5	..do	Level	0.50		12	24.00	
W. C. Giessler	5	..do	Rolling	4.04		97	24.40	
J. Johnson	4		Level	0.511	0.511	12	23.50	
..do	4		Rough	0.511	0.511	118	23.50	
L. Schwartz	5			3.895	1.298		30.30	
Johnson	4		..do	0.511	0.511	12	23.50	
H. C. Peterson	..			0.775		*	*	
J. Johnson	5		Level	0.512	0.512	25	48.80	
..do	5		..do	0.512	0.512	11	21.50	

* No cost given.

TABLE I—

County.	Route.	Beginning.	Ending.	Date of survey.
McLean	7	Sta. 0+00 east city limits of Bloomington	Sta. 1770+00	1-6-16
	16	Sta. 0+00 intersection of routes 15 and 16	Sta. 305	1-10-16
	16	Sta. 305	Sta. 636+56	2-1-16
	15	Sta. 167+86.5 (Sta. 0 is south city limits of Bloomington)	Sta. 369	2-2-16
	15	Sta. 369	Sta. 1095	2-17-16
Menard	7	Sta. 0 intersects west limits of Petersburg	Sta. 40+00	6-5-14
	2	Sta. 0+00 east city limits of Petersburg	Sta. 47+00	2-25-16
Mercer	3	Sta. 0 east city limits of Aledo	Sta. 76+00	1-25-15
	7	Sta. 0 west city limits of Aledo	Sta. 80+00	1-27-15
	8	Sta. 0+00 city limits of Joy	Sta. 94+29.3	5-24-16
	7	Sta. 80+00	Sta. 160+41	5-26-16
	6B	Sta. 0+00 intersection with route 6	Sta. 80+36.6	5-30-16
	6	Sta. 0+00 intersection with route 6B	Sta. 140+20	5-31-16
	2A	Sta. 0+00 Rock Island County line	Sta. 49+75.3	6-2-16
	2	Sta. 0+00 intersection with route 2A	Sta. 112+9.0	6-2-16
Monroe	1	Sta. 0 Monroe and St. Clair Co. line	Sta. 53+00	3-9-14
	1	Sta. 0+00 end of concrete road, Sec. A Sta. 0+00 south city limits of Waterloo	Sta. 45+00 Sta. 60+00	2-18-16
Montgomery	16	Sta. 0+00 north city limits of Litchfield	Sta. 398+00	3-27-16
	1	Sta. 0+00 north city limits of Hillsboro	Sta. 136+38	4-4-16
	12 & 11	Sta. 0+00 west city limits of Hillsboro	Sta. 265+02.4 (Sta. 0 to 48 preliminary)	4-6-16
	2	Sta. 0+00 west city limits of Nokomis	Sta. 327+00	4-7-16
Morgan	4	Sta. 0+00 east city limits of Jacksonville	Sta. 80+61	12-14-14
	11	Sta. 0+00 west city limits of Jacksonville	Sta. 475+74	1-18-16
	7	Sta. 0+00 south city limits of Jacksonville	Sta. 278+38	2-21-16
Moultrie	5	Sta. 0 west city limits of Sullivan	Sta. 79+50	6-17-14
	6	Sta. 0 east city limits of Dalton City	Sta. 172+86	2-9-16
	6A	Sta. 0+00 at intersection of routes 6 and 6-A	Sta. 212+77.3	2-13-16
	5	Sta. 0+00 at south city limits of Bethany	Sta. 144+80	2-16-16
Ogle	3	Sta. 0 at intersection of routes 2 and 3	Sta. 160+00	4-16,17,18-14
	1	Sta. 0+00 north city limits of Oregon	Sta. 111+48.9	2-8-16 3-22-16
	16	Sta. 0+00 on Sec. line of Secs. 29 and 30, Flagg Twp	Sta. 49+37.5	8-11-16
	16	Sta. 49+37.5	Sta. 155+00	11-16-16
Peoria	4	Sta. 0 approximate boundary of city of Peoria	Sta. 160+00	12-19-13
	4	Sta. 160+00	Sta. 242+00	4-17-14
	4	Sta. 242+00	Sta. 464+00	12-6-15
	4	Sta. 464+00	Sta. 582+00	12-18-16
Piatt	2	Sta. 0 a point on south corporate limits of Mansfield	Sta. 78+42.6	1-12-15
	6	Sta. 0 a point on west corporate limits of Monticello	Sta. 185+17.5	
	1	Sta. 0+00 north city limits of Bement	Sta. 84+00	3-6-16
Pike	6	Sta. 0 east city limits of Pittsfield	Sta. 84+60	12-17-14
	4	Sta. 0 east city limits of Perry	Sta. 147+81	
	4	Sta. 147+81	Sta. 255+33	
Pulaski	1	Sta. 0+00 south line of Sec. 34, T. 15 S., R. 1 W. 3 P. M	Sta. 100+95	6-2-16
Putnam	4	Sta. 0+00 (¼ mi. west of C. & A. Station at McNabb)	Sta. 164	1-10-16
	4	Sta. 164+00	Sta. 205	10-31-16
Randolph	3	Sta. 0 east city limits of Steelville	Sta. 42+00	6-23-14
Richland	2	Sta. 0+00 Olney-Claremont Twp. line	Sta. 119	5-1-16
	4	Sta. 0+00 Olney-Noble Twp. line	Sta. 152+69	5-4-16
Rock Island	8A	Sta. 0 north city limits of Sears	Sta. 10+53.5	5-20-14
	3	Sta. 0+00 east line Sec. 2, Zuma Twp	Sta. 47+00	5-21-14
	11	Sta. 0+00 Twp. line at Taylor Ridge	Sta. 50+00	5-22-14

Continued.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day.	Total cost of survey.	Average cost per mile.	Remarks.
E. B. Blough	4	Cold, wet, muddy	Rolling	33.50	1.20	$686	$20.50	
F. C. Feutz	4	Cold and stormy	..do	5.78	0.72	217	37.50	
W. C. Locke	4	..do	..do	6.29	1.05	164	26.40	
..do	4	Cold and rain	..do	3.81	1.27	63	16.50	
E. B. Blough	4	Cold and muddy	..do	13.71	1.15	261	19.00	
L. Schwartz	5		Rough	0.758	0.505	25	33.00	
C. S. McArdle	5	Cold	..do	0.890	0.445	46	51.70	
H. E. Surman	5		Level	1.44	0.72	38	26.40	
..do	5		..do	1.515	0.757	38	25.10	
O. F. Goeke	5	Rain and mud	Rough	1.79	0.90	38	21.20	
..do	5	Fair	Rolling	1.52	0.76	34	22.40	
..do	5	Fair and muddy	Level	1.52	1.52	31	20.35	
..do	5	..do	..do	2.65	1.32	57	21.50	
..do	5	..do	Rolling	0.94	1.25	14	14.90	
..do	5	..do	..do	2.12	1.70	30	14.15	
F. Tarrant	5		Level	1.00	1.00	45	45.00	
B. C. McCurdy	4		..do / Rolling	2.00	0.44	59	29.70	
O. B. Kercher	9		Level	7.54	0.84	227	30.10	
..do	5		Rolling	2.58	0.86	69	26.75	
..do	5	Fair	..do	4.11	0.685	120	29.20	
..do	4	..do	Level	6.19	0.728	192	31.00	
M. W. Watson	5		..do	1.525	0.61	73	47.80	
C. C. Hinsdale	5	Cold	Rolling	9.00	0.710	266	29.60	
..do	5	..do	..do	5.27	0.820	135	25.60	
J. E. Huber	5		Level	1.51	0.755	32	21.20	
P. F. Jervis	4	Muddy	..do	3.26	1.09	48	14.75	
..do	4	..do	..do	4.03	1.15	61	15.25	
..do	4	Snow and rain	..do	2.84	0.95	53	18.50	
C. M. Hathaway	5	Fair	Rough	3.03	1.01	73	24.10	
O. F. Goeke	5	Cold and snow	..do	2.11	0.42	100	47.50	
E. J. Hewit	5	Fair	Level	0.94	0.94	19	20.20	
..do	5	..do	..do	2.00	1.14	39	19.50	
Bushnell and Hathaway	7	Cold and stormy	Rough	3.03	0.606	183	60.40	
R. L. Bell	5	Fair	..do	1.55	0.78	57	36.80	
C. R. French	4	Cold	..do	4.20	0.60	137	32.65	
W. C. Locke	4	Cold and snow	Rolling	1.28	0.64	43	33.70	
F. Tarrant	5		Level	1.485	0.495	67	45.10	
C. C. Hinsdale				3.505				
E. B. Gordon	3	Warm	Level	1.60	0.800	29	18.00	
M. W. Watson	5		Rolling	1.60	0.64	67	41.90	
E. B. Gordon			Rough	2.800		115	23.98	
..do			..do	2.038				
R. P. Devine	5	Rain	..do	1.91	0.64	52	27.10	
W. C. Giessler	4	Cold	Rolling	3.10	0.50	101	32.45	
..do	2	Fair	..do	0.78	0.39	22	27.65	
J. E. Huber			Level	0.795				
F. C. Feutz	4	Rain	..do	2.25	0.75	54	24.00	
..do	4	Fair	Rough	2.89	1.445	35	12.20	
C. M. Hathaway	5		Level	0.20	0.40	13	65.00	
..do	5		..do	0.89	0.89	23	25.80	
..do	5		..do	0.95	0.95	10	10.50	

TABLE I—

County.	Route.	Beginning.	Ending.	Date of survey.
Rock Island.	9	Sta. 0+00 southwest cor. of village of Milan	Sta. 60+00	2-1-16
	3	Sta. 0+00	Sta. 64+32.8	2-3-16
	5	Sta. 0+00	Sta. 58+00	8-24-16
Saline	1	Sta. 0 a point between Harrisburg and Raleigh Twps	Sta. 90+00	2-3-14
Sangamon	6	Sta. 0 west end of 36 ft. pavement on Laurel St	Sta. 131+45	12-22-13
	9	Sta. 0 intersection Amos Av. and Jefferson St	Sta. 77+17.6	12-27-13
	3c	Sta. 0 east city limits on Washington Street	Sta. 82+00	12-31-13
	5	Sta. 44+00, 1,400 ft. south of south city limits of Springfield	Sta. 124+00	1-2-14
	2	Sta. 60+26 6,100 ft. north of north city limits of Springfield	Sta. 130+00	1-5-14
	4	Sat. 0+00 east city limits of Springfield	Sta. 30+00	2-27-15
	5	Sta. 122+00	Sta. 323+51.5	11-5-15
	5	Sta. 324+00	Sta. 351+78.5	
	3	Sta. 0+00 east city limits of Springfield	Sta. 215+61.2	11-18-15
Schuyler	5	Sta. 0 north city limits of Rushville	Sta. 78+64	4-8-14
		Sta. 78+64	Sta. 127+00	11-22-15
	6	Sta. 0+00	Sta. 16+00	11-24-15
	2	Sta. 0+00 east city limits of Rushville	Sta. 80+00	12-11-16
	1	Sta. 0+00 north city limits of Rushville	Sta. 76+00	12-13-16
Scott	4	Sta. 0 west city limits of Winchester, a point at west end of Sand Creek bridge	Sta. 47+70	4-11-14
	7	Sta. 0+00 west city limits of Glasgow	Sta. 65+33	1-15-16
	1	Sta. 0+00 south city limits of Bluffs	Sta. 87+00	1-24-16
	6	Sta. 0+00 west city limits of Winchester	Sta. 150+00 (1,100 ft. relocation)	1-3-16
Shelby	15	Sta. 0+00 west city limits of Shelbyville	Sta. 65+00	2-17-15
	1	Sta. 0+00 at Austins Corner	Sta. 162+00	12-6-15
	1	Sta. 157+00	Sta. 317+00	
	5	Sta. 0+00 1½ miles east of Shelbyville	Sta. 158+00	12-6-15
	5	Sta. 158+00	Sta. 255+39.8	12-7-15
	11	Sta. 0+00 1 mile south of Shelbyville	Sta. 159+00	12-8-15
	11	Sta. 159+00	Sta. 205+67.4	12-9-15
	15	Sta. 64+00	Sta. 160+00	12-22-15
	15	Sta. 159+00	Sta. 267+12.7	12- -15
Stark	5	Sta. 0+00 east city limits of Toulon	Sta. 80+00	4-16-14
	5	Sta. 0+00 east city limits of Lafayette	Sta. 295+80	2-12-16
	5	Sta. 80+00	Sta. 262+86.7	2-22-16
St. Clair	14	Sta. 0+00 east city limits of E. St. Louis	Sta. 111+00	11-22-14
	4	Sta. 0+00 south city limits of Belleville	Sta. 331+04.5	3-14-16
	2	Sta. 0+00 east city limits of Belleville	Sta. 191+00	3-22-16
	14	Sta. 0+00 end of concrete road	Sta. 311+63.7	3-30-16
	10	Sta. 0+00 south city limits of E. St. Louis	Sta. 270+15	4-3-16
	14 & 2	Sta. 0+00	Sta. 297+20.3 and 16+44.1	6-26-16
Stephenson	9	Sta. 0+00 southeast city limits of Freeport	Sta. 80+00	4-23,24,25-14
	13	Sta. 0 southwest city limits of Freeport	Sta. 26+90	7-14-15
	1	Sta. 0+00 north city limits of Freeport	Sta. 106+00	4-10-16
	1	Sta. 106+00	Sta. 162+13.6	5-8-16
	6	Sta. 0+00 northeast city limits of Freeport	Sta. 81+00	12-4-16

Continued.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day.	Total cost of survey.	Average cost per mile.	Remarks.
O. F. Goeke	5	Cold and snow	Level	1.13	0.75	$ 27	$23.90	
..do	5	..do	Rolling	1.22	0.61	40	32.80	
..do	5	Fair	Rough	1.10	0.55	27	24.55	
Bell and Tarrant	6	Rain and muddy	Level	1.70	0.850	57	33.50	
F. Tarrant	5	20–40° stormy	..do	2.49	0.830	50	20.10	
..do	6	Cold, snow on ground	..do	1.46	0.486	60	41.10	
..do	5	Snow on ground	..do	1.55	1.55	18	11.60	
..do	5	..do	..do	1.515	0.757	29	19.15	
..do	5	..do	..do	2.27	0.649	49	21.60	
..do	4		..do	0.568	0.568	17	29.90	
C. S. McArdle			..do	3.817		223	51.35	
..do			..do	0.526				
..do			..do	4.080		177	43.38	
R. L. Bell	5		..do	1.49	1.49	32	21.50	
F. Tarrant	5			0.92	0.46	22	23.90	
..do			..do	0.303	1.515	5	25.00	
C. S. McArdle	5	Clear and cold	Rough	1.52	1.000	55	36.20	
..do	5	..do	Level	1.44	0.960	30	20.80	
R. L. Bell			Rough	0.90	0.90	32	35.60	
B. C. McCurdy	5		..do	1.80	0.60	69	38.30	
..do	5		..do	1.65	0.50	80	48.50	
..do	5		..do	3.05	0.38	204	67.00	
F. Tarrant	5		Rolling	1.230	0.615	54	43.90	
H. B. Emery			Level	3.070		*	*	
..do			..do	3.080	0.762	*	*	
C. C. Hinsdale	5		..do	2.990				
..do	5		..do	1.840	1.207	95	19.65	
..do	5		Rolling	3.010				
..do	5		Level	0.884	0.556	111	28.55	
H. B. Emery	5	Rain and sleet	..do	1.817				
..do	5	..do	Rolling	2.045	0.772	111	28.55	
R. L. Bell	5		Level	1.515	1.515	28	18.50	
W. J. Griffin	5		Rolling	5.60	0.70	169	30.20	
..do	5		..do	3.45	0.58	113	32.80	
M. W. Watson	5		Rough	2.667	0.76	101	37.75	
B. C. McCurdy	5	Cold	Rolling	6.27	0.545	220	35.00	
C. I. Burggraf	4							
B. C. McCurdy	5		Rough	3.61	0.45	153	42.40	
C. I. Burggraf	4							
B. C. McCurdy	5		Level	5.90	0.787	110	18.65	
C. I. Burggraf	4							
B. C. McCurdy	5	Fair	..do	5.12	0.40	169	33.00	
C. I. Burggraf	4							
S. Krebs	5					*	*	(1)
C. M. Hathaway	5	Fair	Rough	1.515	0.77	65	42.90	
H. E. Surman	4		Level	0.509	0.509	24	47.20	
O. F. Goeke	5	Fair	Rolling	2.00	1.00	49	24.50	
..do	5	Windy and fair	..do	1.06	1.06	30	28.30	
R. E. Thomas	5	Fair	Rough	1.53	0.76	41	26.80	

* No cost given. [1] Made by county.

TABLE I—

County.	Route.	Beginning.	Ending.	Date of survey.
Tazewell....	10	Sta. 0 south city limits of Pekin.....	Sta. 53+00.....	6-1-14
	11	Sta. 0 corporation limits of Tremont....	Sta. 40+00.....	6-2-14
	9A	Sta. 0 east city limits of Delavan.....	Sta. 42+80.....	6-3-14
	2	Sta. 0+00 west city limits of Washington.....	Sta. 79+00.....	7-15-16
	2	Sta. 0+00 east city limits of E. Peoria..	Sta. 49+00.....	7-17-16
	10	Sta. 0+00 (12,580 ft. south of city limits of Pekin).....	Sta. 53+00.....	6- -14
Union.....	1	Sta. 0 north corporate limits of Anna...	Sta. 66+00.....	11-19-14
	1	Sta. 66+00.....	Sta. 123+60.....	3-3,4-16
	7	Sta. 0+00 north city limits of Dongola..	Sta. 81+07.....	3-4,5-16
Vermilion...	2	Sta. 0 north city limits of Danville.....	Sta. 202+00.....	2-4-14
	2	Sta. 180+75 resurvey.....	Sta. 201+53.2.....	.....
	2	Sta. 0+00.....	Sta. 173+54.5.....	.....
	2	Sta. 0+00=Sta. 201+53.2.....	Sta. 178+21.1.....	.....
	2	Sta. 0+00.....	Sta. 178+00.....	.....
Wabash.....	2	Sta. 0+00, 2 miles north of Mt. Carmel..	Sta. 108+00.....	4-5-15
	4	Sta. 0+00 on ¼ Sec. line, Sec. 15, T. 1 S., R. 13 W.....	Sta. 108+00.....	1-19,20-16
	1	Sta. 0+00 S. W. cor. S. E. ¼ N. W. ¼ Sec. 6, T. 1 S., R. 12 W.....	Sta. 81+60.5.....	12-1,2-16
Warren.....	12	Sta. 0+00 west city limits of Monmouth	Sta. 83+12.5 (Sta. 0+00 to Sta. 30+73 prelim.)..	4-8-15 5-25-14
	7	Sta. 0+00 south city limits of Monmouth.....	Sta. 106+00 (Sta. 0+00 to Sta. 26+53 prelim.)....	5-26-14
	13	Sta. 0+00 intersection with route 12....	Sta. 69+00.....	4-4-16
	11	Sta. 0+00 intersection with route 7.....	Sta. 78+58.5.....	4-5-16
	7	Sta. 106+00.....	Sta. 158+68.3.....	4-6-16
	5	Sta. 0+00 intersection with route 6.....	Sta. 81+8.9.....	4-7-16
	1	Sta. 0+00.....	Sta. 82+03.6.....	4-13-16
	3	Sta. 0+00 Monmouth-Coldbrook Twp. line.....	Sta. 80+00.....	4-14-16
	4	Sta. 0+00 intersection with route 3.....	Sta. 60+00.....	4-15-16
Washington.	1	Sta. 0+00 northeast city limits of Nashville.....	Sta. 318+13.7.....	7-17-16
White.....	11	Sta. 0+00 east city limits of Carmi.....	Sta. 131+00.....	2-5-15
Whiteside...	6	Sta. 0+00 north line Sec. 31, T. 21 N., R. 5. E.....	Sta. 162+00 (Sta. 0+00 to Sta. 106+63 Prelim.)...	5-14,15-14
	1	Sta. 2+03 (Sta. 0 west city limits of Morrison).....	Sta. 29+00.....	8-17-14
	1	Sta. 0 east city limits of Morrison.....	Sta. 188+00 (13,625 ft. prelim.).....	8-18-14
	8	Sta. 0+00 east city limits of Coleta.....	Sta. 142+31.....	2-14-16
	9	Sta. 0+00 Coloma-Montmorency Twp. line.....	Sta. 160+00.....	2-17-16
	1	Sta. 0+00.....	Sta. 108+00.....	12-14-16
Will.....	24	Sta. 0+00.....	Sta. 53+40.....	4-29-14
	24	Sta. 0 a point on Indiana-Illinois line...	Sta. 222+20.....	4-23-14
	24	Sta. 0+00.....	Sta. 36+41.....	5-5-14
	22	Sta. 0+00.....	Sta. 26+74.8.....	5-6-14
	22	Sta. 0+00.....	Sta. 193+00.....	4-30 to 5-9-14
	22	Sta. 193+00.....	Sta. 333+00.....	
	13	Sta. 0 intersects northwest city limits Joliet.....	Sta. 132+00.....	6-9-14
	2	Sta. 0 west city limits of Joliet.....	Sta. 215+00 (2,931 ft. prelim.).....	6-12-14
	13	Sta. 132+00.....	Sta. 198+00.....	6-2-14
	8	Sta. 0+00 north side of Ritchie.....	Sta. 238+50.....	12-13,21-16
	24	Sta. 0+00 east city limits of Peotone....	Sta. 162+00.....	12-1,5-16
	25	Sta. 0+00 west of Peotone.....	Sta. 266+00.....	12-6,12-16
Williamson..	11	Sta. 0+00 I. C. switch west of Culp.....	Sta. 36+76.....	1-25-16
	1	Sta. 0+00 north Twp. line of W. Marion Twp.....	Sta. 178+00.....	1-27-16 2-3-16
	1A	Sta. 0+00 intersection with route No. 1	Sta. 220+00.....	2-7,10-16
	9	Sta. 0+00 east city limits of Hurst.....	Sta. 66+76.....	2-15-16
	10	Sta. 0+00 intersection with route 8.....	Sta. 138+6.....	2-16-16

Continued.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day.	Total cost of survey.	Average cost per mile.	Remarks.
L. Schwartz	5		Rolling	1.00	0.50	51	51.00	
..do	5		Level	0.758	0.379	24	31.65	
..do	5		..do	0.811	0.405	41	50.50	
A. K. Fogg	4	Hot	Rolling	1.50	.....	33	21.70	
..do	4	..do	..do	0.93	.....	15	15.90	
John Johnson	5		Level	1.00	1.00	40	40.00	
M. W. Watson	4		..do	1.25	0.50	47	37.60	
M. J. Fleming	5	Cold and fair	Rough	1.09	0.54	37	33.50	
..do	5	Muddy	..do	1.53	0.77	35	23.10	
H. B. Bushnell	5	Rain	Level	3.83	0.639	232	60.60	
R. L. Bell	..			0.394	.....	*	*	
Wm. S. Dillon	..			3.290	.....	*	*	(1)
..do	..			3.375	.....	*	*	(1)
..do	..			3.370	.....	*	*	(1)
L. Schwartz	4		Level	2.047	1.365	33	16.10	
M. J. Fleming	5	Muddy and stormy	Rough	2.04	1.02	41	20.20	
..do	5	Fair	..do	1.55	0.78	42	27.10	
H. E. Surman	5		Level	1.57	0.523	65	41.40	
C. M. Hathaway	2							
..do	5		..do	2.01	1.005	32	15.90	
O. F. Goeke	5	Fair	..do	1.30	1.04	23	17.70	
..do	5	..do	..do	1.48	1.20	21	14.20	
..do	5	..do	..do	1.00	1.00	20	20.00	
..do	5	..do	..do	1.55	1.25	22	14.15	
..do	5	..do	..do	1.55	1.55	24	15.45	
..do	5	..do	..do	1.51	1.51	24	15.85	
..do	5	..do	Rolling	1.14	1.14	23	20.20	
J. A. Davenport	5		Level	6.02	1.00	114	19.00	
J. E. Huber	5		Rough	2.480	1.240	61	24.60	(5)
C. M. Hathaway	5		Level	3.07	2.046	34	11.10	
H. E. Surman	5		Rolling	0.511	0.511	24	47.00	
..do	5		Level	3.56	1.78	46	12.90	
O. F. Goeke	5	Cold and snow	Rolling	2.70	0.90	65	24.10	
O. F. Goeke	5	Fair	Level	3.03	1.21	61	20.10	
E. L. Schwaderer	5	Cold and snow	Rough	2.04	1.02	62	30.40	
F. Tarrant	5		..do	1.01	1.01	19	19.00	
..do	5		Level	4.21	1.052	55	13.00	
..do	4		Rough	0.69	0.69	16	23.20	
..do	4		Level	0.51	0.51	8	15.70	
..do	5	Rainy	..do	3.65	0.63	138	21.90	
		..do	..do	2.65				
L. Schwartz	5		Rolling	2.50	0.625	101	40.40	
..do	5		Rough	4.07	0.679	170	41.75	
..do	5		Level	1.25	1.25	45	36.00	
H. M. Kleiser	5	Cold and snow	Rough and rolling	4.52	0.65	154	34.10	
..do	5	Cool	Rolling	3.07	0.77	97	31.50	
..do	5	Cool and rainy	..do	5.04	0.84	137	27.20	
M. J. Fleming	4	Fair	..do	0.70	0.70	18	25.70	
M. J. Fleming	5	Rainy	Rough	3.37	0.67	87	25.80	
..do	5	Fair and cold	..do	4.17	1.04	61	14.60	
..do	5	Fair and muddy	Rolling	1.26	1.26	18	14.50	
..do	5	Muddy	..do	2.61	0.65	64	24.60	

* No cost given. [1] Made by county. [5] Part of work relocated. No cost given.

TABLE I—

County.	Route.	Beginning.	Ending.	Date of survey.
Winnebago..	10	Sta. 0 West Twp. line of Rockford Twp.....	Sta. 91+75.....	7-18-14
	11	Sta. 1+00 north Twp. line of Rockford Twp.....	Sta. 60+24.5.....	7-20-14
			Sta. 107+99.5.....	9-29-14
	6	Sta. 0+00 south city limits of Rockford	Sta. 114+64.....	10-28-16
				11-21-16
	11	Sta. 0+00 N. W. end Winnebago.....	Sta. 23+50.....	11-21-16
Woodford...	1	Sta. 0 north city limits of Eureka.....	Sta. 104+00.....	4-14,15-14
	1	Sta. 104.....	Sta. 233.....	2-6-16
	10	Sta. 0+00 west city limits of Eureka...	Sta. 186.....	2-8-16
	4	Sta. 0+00 east city limits of Metamora.	Sta. 400.....	2-12-16
—	7	Sta. 0+00 east city limits of Eureka....	Sta. 435+53.....	2-20-16
	6	Sta. 0+00 north city limits of ElPaso...	Sta. 583+37.....	8-1-16

Concluded.

Chief of party.	Total in party.	Weather.	Topography.	Total number miles surveyed.	Average number miles per work day.	Total cost of survey.	Average cost per miles.	Remarks.
J. Johnson	4		Level	1.735	0.867	$ 30	$17.30	
J. Johnson R. H. Baldwin	4		Rolling	1.122 0.905	0.561	30	26.75	
L. Schwartz	5	Cool and fair	do	2.17	0.87	68	31.20	
do	5	do	do	0.44	0.88	11	26.15	
R. L. Bell	5		Rough	1.97	0.985	47	23.90	
W. C. Giessler	4	Sloppy—cold	do	2.44		48	19.65	
W. C. Giessler	4	Cold	Rolling	3.52	0.71	54	15.40	
do	4	do	do	7.54		113	15.05	
A. K. Fogg	4	do	do	8.25	1.18	99	12.00	
do	4	Hot	do	11.10	1.23	154	14.00	

Fig. 1. Though the right of way is straight, lack of improvement has caused the snake trail. Route 2, Marshall County.

Fig. 2. The traveling public is properly demanding the elimination of reverses like this. Kickapoo Township, Peoria County.

STATE AID ROAD IMPROVEMENT.

On July 1, 1914, bids were opened by the State Highway Commission for the improvement of the first State aid roads in the history of Illinois. These bids covered 29 separate jobs and each provided for an improvement of the highway with a surface of either brick or Portland cement concrete. To a road in Ogle County, designated as Section A and as Contract No. 1, falls the distinction of being the first job to be awarded. This was an improvement with brick 10 feet in width and 8,500 feet in length. From July 1, 1914, until December 31, 1916, there were awarded by the commission a total of 276 State aid road jobs as shown in detail by Table II.

Either brick or Portland cement concrete made up 187, or 68 per cent, of these jobs. The following table shows the number of each of the seven types of improvements that made up the work, and also the percentage of this number to the total.

Types of improvements.	Number of each type.	Percentage of each type to total number.
Concrete	132	47.8%
Brick	55	19.9%
Earth	54	19.6%
Gravel	16	5.8%
Waterbound macadam	11	4.0%
Bituminous macadam	7	2.5%
Bituminous concrete	1	0.4%
Total	276	100.0%

The high percentage of brick and concrete roads is largely accounted for by the fact that very little modern road improvement having been done in the State, the requirements of traffic have grown beyond what could economically be satisfied by the use of either gravel or macadam. This, in addition to the fact that the highways selected for improvement were in most cases those carrying the greatest traffic from the largest cities in the counties, seemed to warrant a more durable type of improvement than could have been provided by the less expensive types.

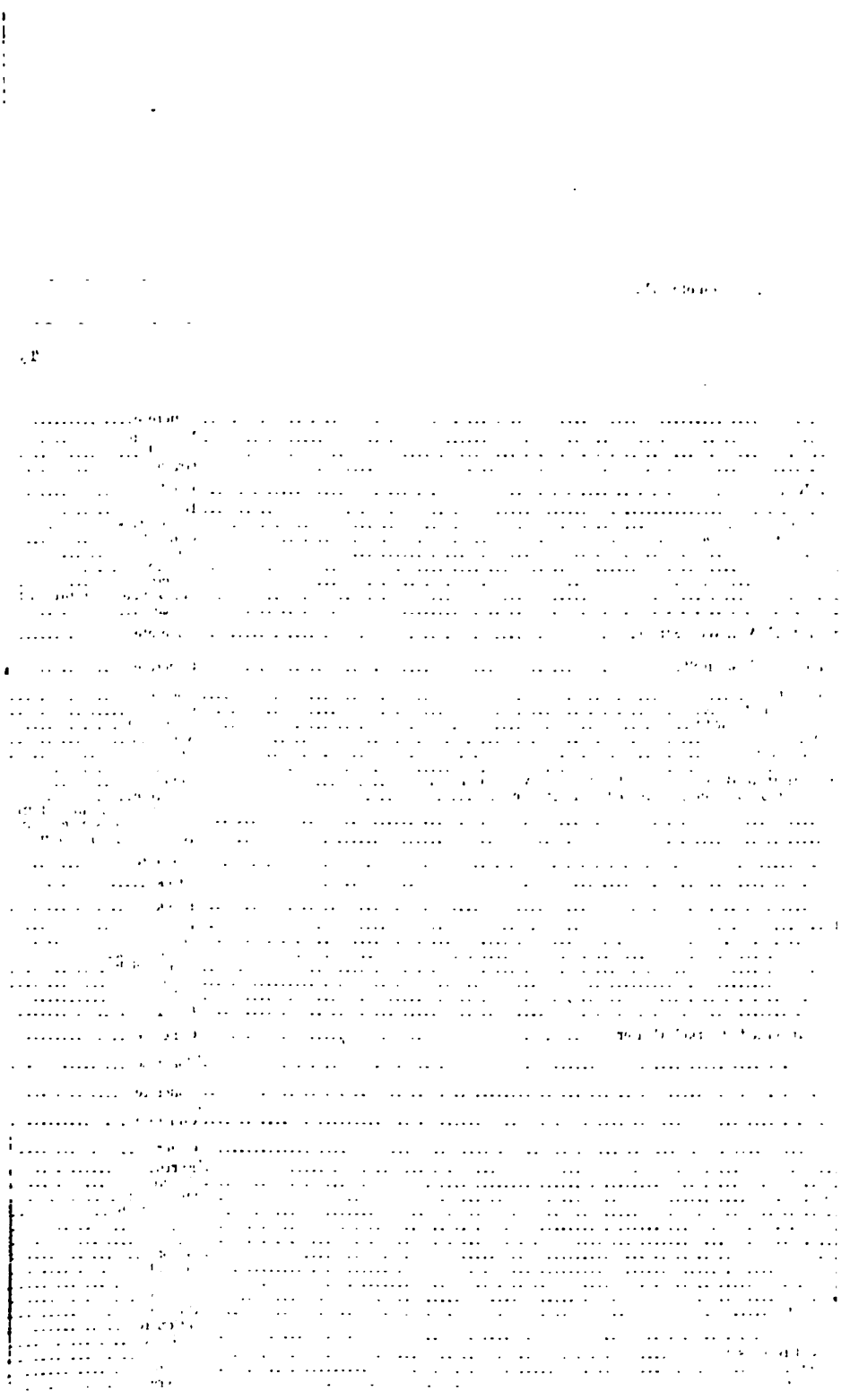
It is interesting to note that the lengths of the improvements varied from 61,989 feet, or about 11.8 miles, to only 445 feet, or about 0.08 miles. The average length of all the jobs as awarded was 8,600 feet, or about 1.6 miles. In the following table will be seen the longest, the shortest and the average length in feet of each of the seven types of improvements made.

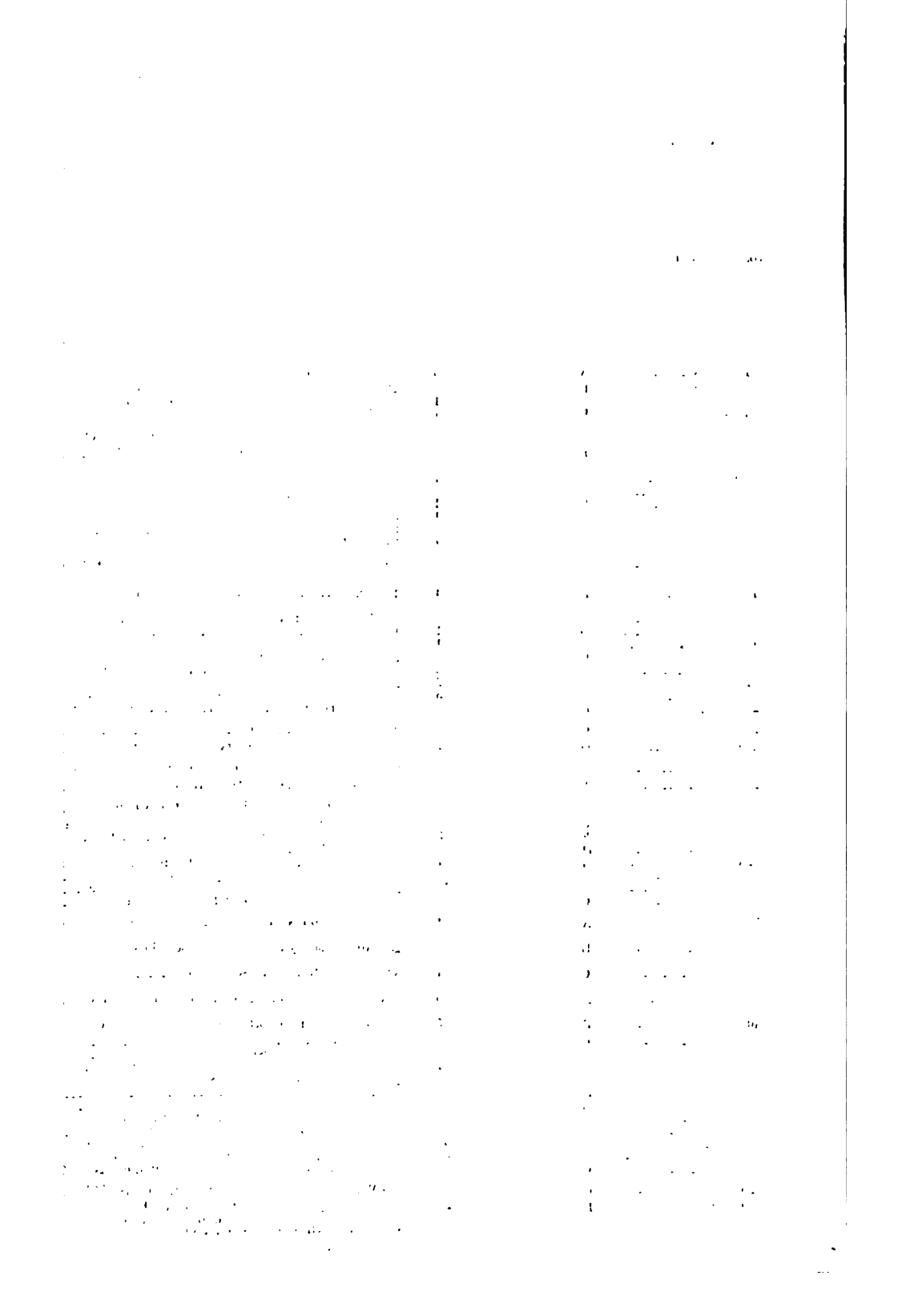
Types of improvements.	Longest length.	Shortest length.	Average length.
Concrete	24,000 feet	445 feet	6,110 feet
Brick	16,200 "	600 "	5,730 "
Earth	61,989 "	2,550 "	18,080 "
Gravel	17,842 "	1,750 "	8,200 "
Waterbound macadam	10,560 "	1,920 "	6,070 "
Bituminous macadam	19,192 "	5,150 "	9,380 "
Bituminous concrete	7,981 "	7,981 "	7,981 "

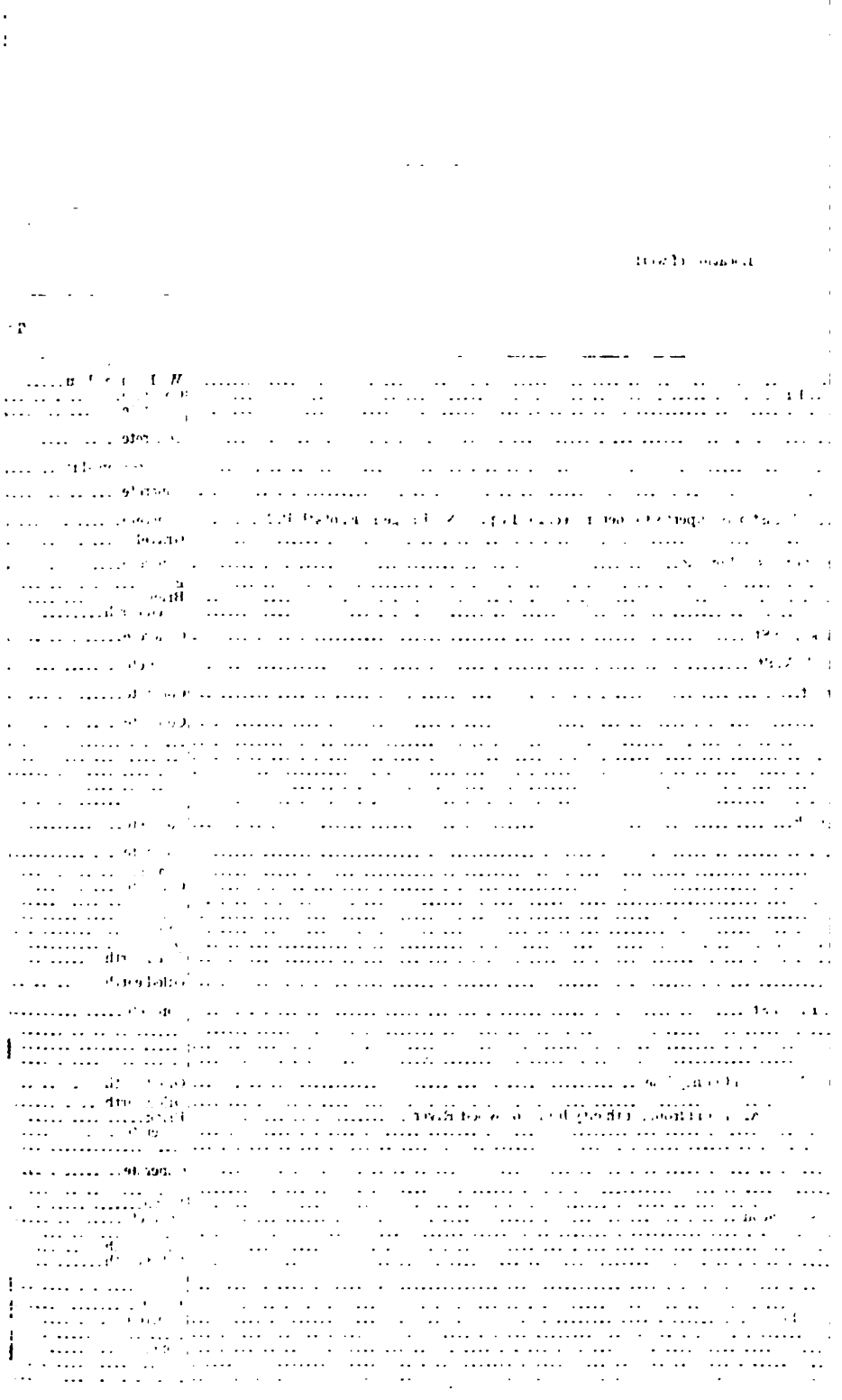
Average length of all jobs 8,600 feet, or about 1.6 miles.

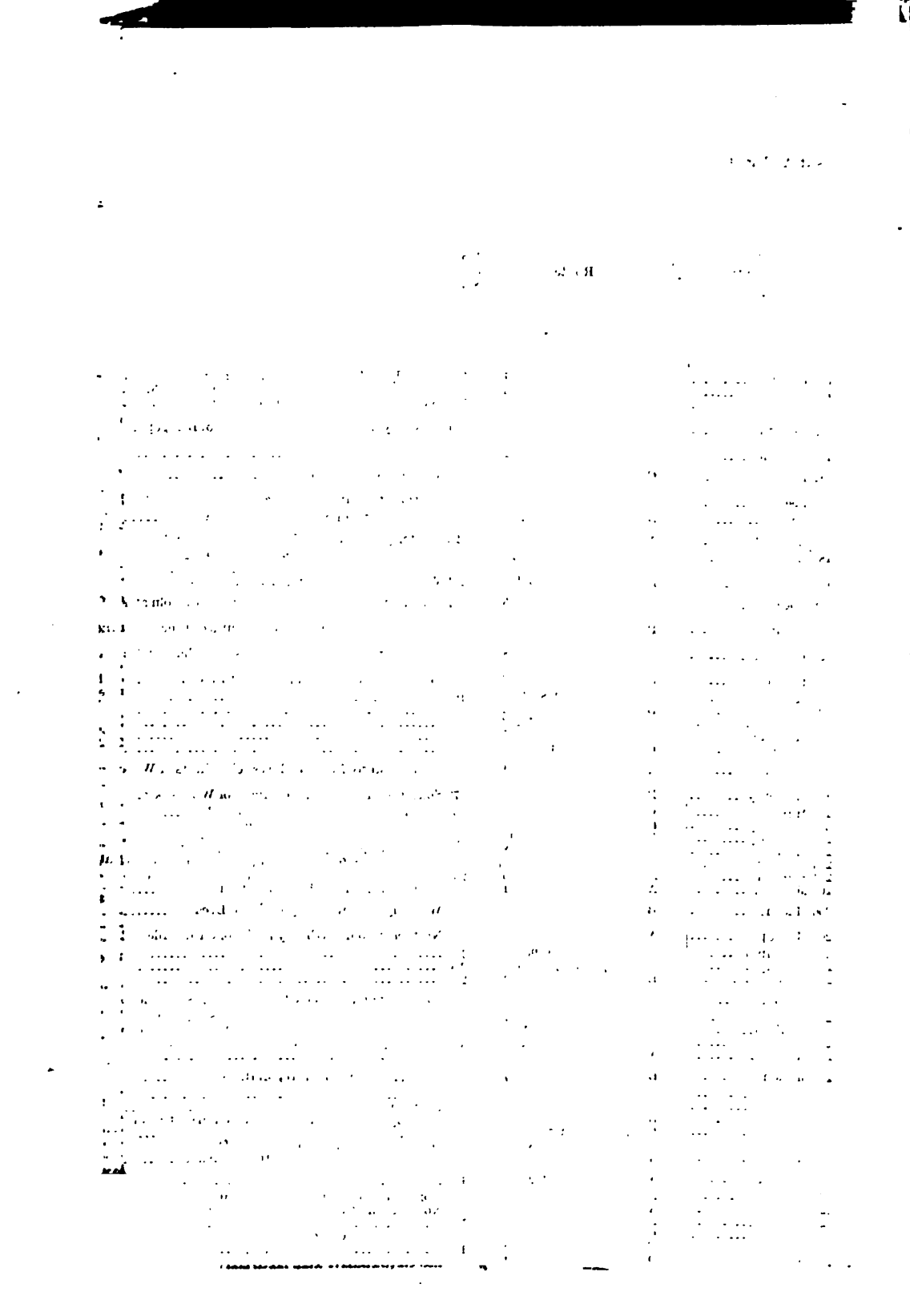
Fig. 3. Not all of Illinois is level. Grade being reduced from 14 to 9 per cent, which is the lowest practicable. Section D, LaSalle County.

Fig. 4. Peculiar formation of rock that is excellent for road work. Novaculite or "Elco Gravel" at Tamms, Alexander County, Illinois.









By Table II it will be noted that the widths of the metaled way on the several jobs varied from 9 to 30 feet as the extremes, but that the prevailing widths were 10, 15 and 18 feet. These three widths have been adopted as standards to be followed under all except extreme conditions, irrespective of the type of the improvement. The 10 foot width is adapted to a single line of traffic and the 15 and 18 foot widths are intended to accommodate two lines of traffic, the 18 being used when the traffic is very dense. It has been found that for two lines of motor traffic a width of 18 feet is the narrowest that can safely be used. This traffic is usually not encountered, however, except on highways near cities having a population of 30,000 and upwards.

For an ordinary amount of mixed traffic the 15 foot width can be considered as a double track road, and the mileage of highways upon which a 15 foot pavement would be warranted and satisfactory is far in excess of the mileage upon which an 18 foot pavement is needed. This fact warrants in strong terms a width between 10 and 18 feet.

It will be noted that more than half of the jobs were provided with a pavement 10 feet in width, this being considered as sufficient for a single track only. Much pressure has been brought to bear at times to build a 9 foot width rather than 10, on the argument that since neither provides more than a single track the 9 foot one is equally satisfactory and less expensive. This argument has more force when gravel or macadam roads are under consideration than when either concrete or brick are being discussed. It can with reason be expected that the speed of traffic will be somewhat in proportion to the smoothness and rigidity of the pavement. Upon concrete and brick pavements, speeds of 30 to 60 miles per hour in rural territory are quite common, so any advantage in a reduction below 10 feet is more than off-set by the increased danger of the high speed traffic. After having built a large number of these 10 foot concrete and brick pavements, there has not been observed any sound argument for reducing the width.

On the larger number of these jobs the width of the graded roadway, that is the crowned width between ditches upon which it would be practicable to drive, was 30 feet. When a 10 foot pavement is used this roadway width provides also a 10 foot earth road on either side of the pavement. In some of the work gravel or macadam shoulders three or four feet in width have been used along the sides of the 10 foot pavement for the purpose of permitting the traffic to turn out and return to the pavement with greater freedom. These shoulders were génerally built 5 inches in thickness and in most cases consisted of little more than the placing of loose gravel or crushed stone and screenings with little or no rolling. On some jobs they have been considered successful and well worth the expense, but as a rule it would seem that a better practice would be to build at least a 15 foot pavement under conditions where metal shoulders would be needed with a 10 foot one.

In a few of the counties it was realized that the improvement of the highways was more urgent in the way of building permanent culverts and bridges than in improving the surface of the road. Consequently, the State aid bridge work shown in the table was carried out in the

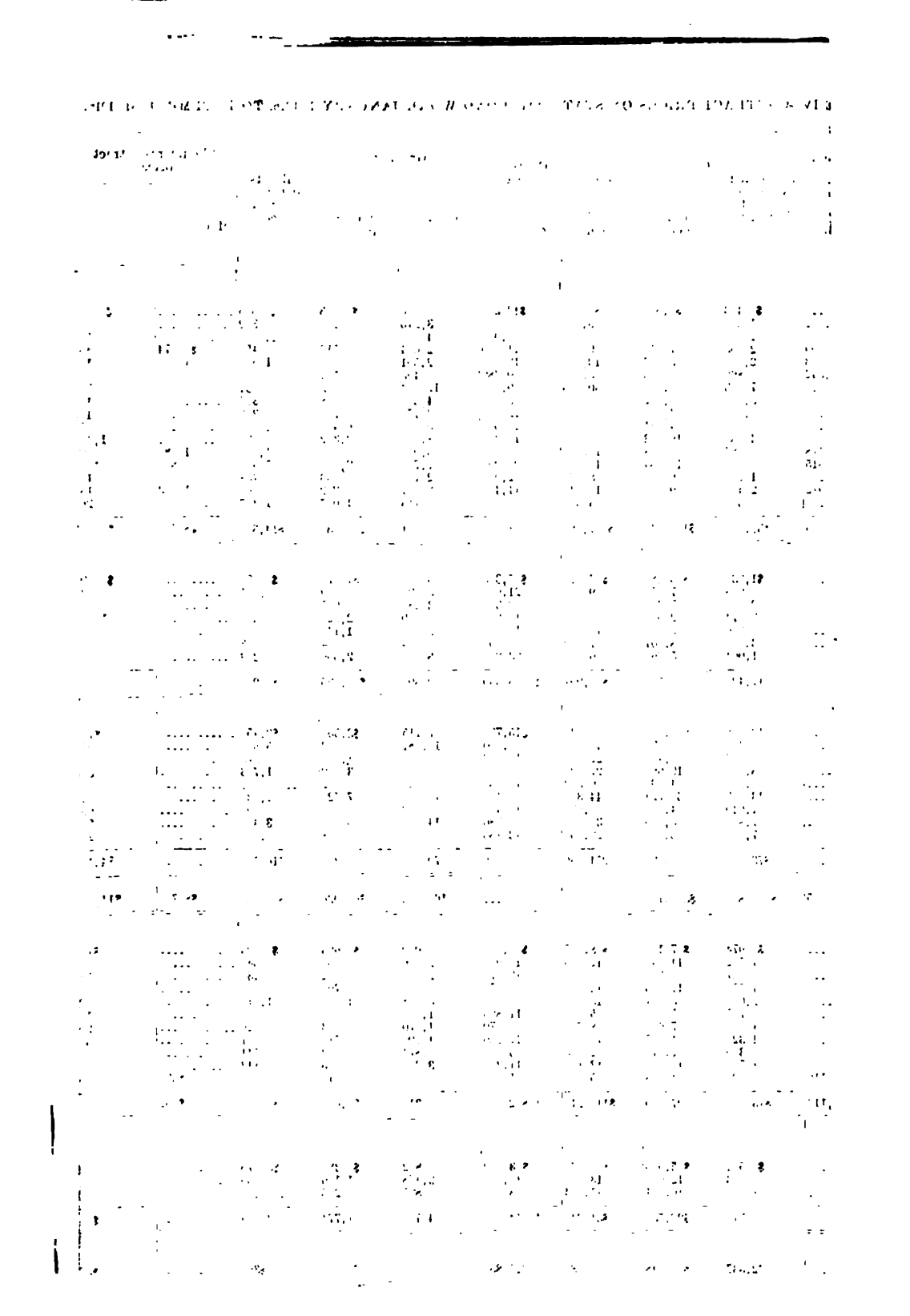
Fig. 5. Under certain conditions, motor truck hauling reduces the construction cost. Section E, Cook County.

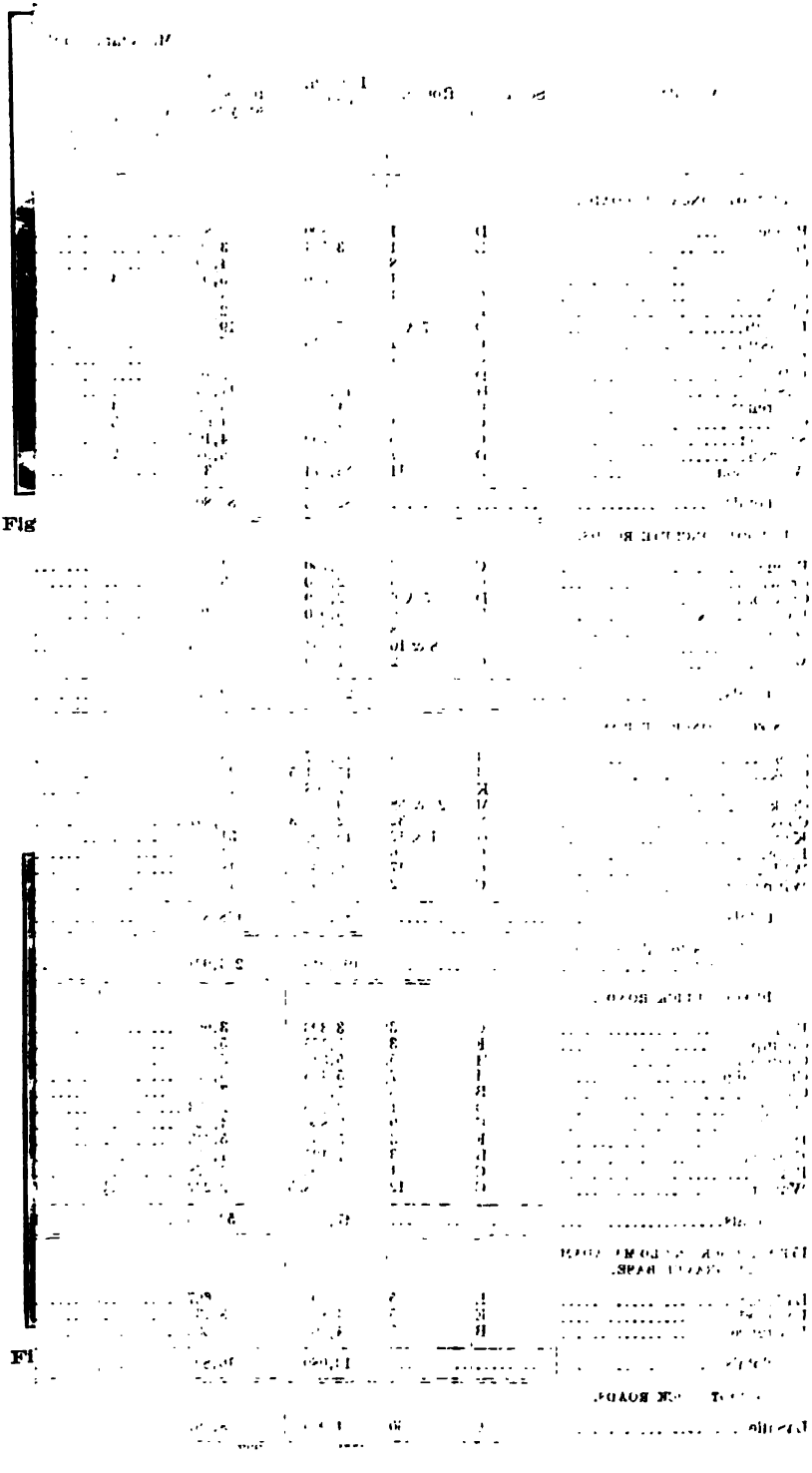
Fig. 6. Forms set and aggregates and cement in place ready to mix for concrete base of brick road. Section A, Edgar County.

REL III- COSTRUZIONE E POSA IN OPERA DELLE BOCCHE - WORK DELAY LIKELY TO DEC. 3RD, R.O.

Fig. 5.

Fig. 6.





same manner as other road improvement. In the design, location and construction of these culverts and bridges, full consideration was given to the future improvement of the highway, in order that they would fit in as an integral part of the later improvement.

Since the law provides that State aid work cannot be awarded at a figure higher than the engineer's estimate which was kept as low as possible, there will be noted in the table some variation between this estimate and the contract price. In some cases the work was awarded at a figure only a dollar or so below the estimate, but in many cases sharp competition caused the work to be awarded some 10 to 20 per cent below the estimate. When this occurred the remaining money was generally utilized in extending the improvement, an additional contract being awarded at the same unit rate as the original one. This gave rise to the column entitled, "Amount of additional contract."

On work where it was estimated that at least one car of cement would be required, the engineer's estimate as advertised did not include the value of the cement. The practice has been for the State Highway Commission to furnish the contractor with the estimated amount of cement required for the job, this cement being paid for jointly by the State and the county. The value of the cement used in each job is shown in the table.

In discussing the costs of these several jobs the term refers to the construction costs, or those paid by the taxpayers to have the roads built without including any allowance for administration and engineering, which would add from about 5 to 10 per cent more according to the type of improvement, the size of the job and other less important factors.

Except for the consideration of road improvement on a scale much larger than could be carried out by any one county, average costs either per mile or even per square yard for the pavement proper, are of little value. Average figures are of value, however, when intended for use throughout an area as large and reasonably similar to the area from which the figures making up the average were taken. For estimates as to the approximate cost of a system of roads for the State, average costs per mile would be of some value. For any county in Illinois, however, the local conditions might so vary from those that were of influence in producing the averages as to be seriously misleading.

Tables III (Insert B) and IV (Insert C) show the "Contract price on State aid road work," July 1, 1914, to December 31, 1915 and January 1, 1916 to December 31, 1916.

The figures in these two tables were compiled from the actual contract prices as awarded, and are given as an analysis of the unit price of the several items involved.

It is needless to say that with all these jobs distributed over the entire State of Illinois, containing 56,043 square miles, the amount of grading required per mile of road might be expected to vary between wide limits. This variation was confined, however, to only about 15 or 20 of the jobs, the others being typical cases as might reasonably be encountered in dealing with the topographical conditions present. The excavation for grading on all the jobs averaged 4,500 cubic yards per mile and cost $1,300. It might be thought by some that the excavation

Fig. 7. Concrete base and curbs for brick pavement. Practice of using curbs has now been abandoned. Section A, Coles County.

Fig. 8. Applying the finishing touches by dragging the shoulders. Section A, Jackson County brick road.

per mile should not reach this yardage when it is recalled that with the exception of Louisiana and Delaware, Illinois is the most level State in the Union.

A word concerning this feature of the work might not be out of place. In addition to some minor factors, it can be said that the amount of excavation for grading per mile of road hinges chiefly upon the fact as to whether the general topography is practically level, gently rolling or hilly. Other things being equal, more economical and otherwise more satisfactory highway improvement can be carried out on a topography that is gently rolling than on one that is either level or hilly. The hilly topography requires extensive grading, not for drainage purposes, but that the grades may be reduced to the practical minimum. The rolling topography offers almost automatic drainage facilities, and since none of

Fig. 9. Wide and deep ditches through sloughs insure adequate surface drainage. Section F, Cook County.

the hills are excessive there is required the minimum amount of excavation in order to provide the desired roadway for the improvement. With this topography, the natural contour of the country can be followed right along with scarcely any cuts or fills of a depth worth considering.

The level topography, however, presents an entirely different condition, one of extremely difficult drainage and it becomes necessary that there be done a greater amount of excavation for draining than would at first be anticipated. On the greater portion of the mileage of the roads in level country the roadway is actually below the general level of the adjacent fields, making it necessary to elevate the roadway above the field level by borrow pits along the sides of the improvement. These pits need not be very wide or deep to amount to 4,500 cubic yards per mile.

Fig. 10. Construction neatness is an asset and adequate surface drainage a necessity. Section E, Cook County.

Fig. 11. Concrete gutters effectively stop erosion on the roadsides. Section A, Lake County.

The average cost of the drainage structures was $525 per mile. In general, this included concrete culverts up to spans of about 10 feet.

The average cost per mile of the concrete roads has been $10,700 for those 10 feet in width, and $15,600 for those 18 feet. This last figure is about $2,200 lower than would be expected by deducting the fixed cost for grading and culverts and pro-rating directly according to the width of the pavement. The average cost per mile of the brick roads has been $13,800 for the 10 foot widths and $22,200 for those 18 feet wide.

A comparison of the contract price with the engineer's estimate as itemized for the several classes of work involved in each job shows that, including the cost of grading, drainage structures, etc., the cost of the 10 foot concrete road has averaged $1.23 per square yard for the pavement proper, and of the 18 foot ones, $1.16. The corresponding costs of the brick roads are $1.98 and $1.85 respectively.

Fig. 12. A sharp turn is inadequate for modern traffic. Brick road with Novaculite shoulders. Section A, Jackson County.

Even though because of its greater thickness the 18 foot concrete slab contains about 8 per cent more material per square yard than the 10 foot one, its average contract price per square yard is 7 cents lower. This is largely accounted for by the fact that any width of concrete pavement greater than 10 feet can be built more economically per square yard because of the greater volume of material being handled per linear foot of the improvement.

It will be noted that the costs of brick roads are more directly in proportion to the widths than is the case with concrete roads. One reason for this is that the purchase of the brick themselves is made upon a square yardage or a thousand unit basis, making this portion of the cost vary directly as the width of the pavement.

Concerning the brick road, it is only fair to say that due to the recent revision of the specifications and because of the introduction of the monolithic type, the pavement proper, exclusive of grading, drainage structures, etc., can be built at a cost per square yard of from 50 to 60 cents higher than Portland cement concrete.

Fig. 13. The traveling public appreciates a good alignment. Note the easy horizontal and vertical curves. Section, C, LaSalle County.

COUNTY ROAD SYSTEMS.

Even though the proposed system of State aid roads comprises only from 15 to 20 per cent of the total mileage, yet, on the basis of an average cost of $10,000 a mile, it would require from 20 to 25 years to complete it even if the State aid appropriation were increased to $2,500,000 a year, over twice what it is at present. Additional to this fact is the one that figures show the State aid routes as laid out carry about 75 per cent of all the traffic, and that about 75 per cent of the rural population live either on or within one mile of one of these routes.

Realizing, then, that there should be some provision to facilitate a more rapid construction, the Legislature in 1915 amended the Tice Road Law by adding Section 15-d, which allows a county to anticipate the State aid allotments either by using funds available in its treasury, by a special tax, or by a bond issue. Under this amendment a county may at once build a system of roads on its State aid routes, and be reimbursed to the amount of one-half of the construction cost by the State aid allotments as they are made. Upon completion such a system would immediately be taken over by the State for maintenance in the same manner as other State aid construction. Thus, it will be seen that the system would cost the county only its usual one-half plus any interest on the money it may raise, and that in two or three years the completed roads would be at the service of the people instead of there being a delay of 20 to 25 years for a completed system. To give an idea as to how this section of the law has been received, it might be well to state that eight

or nine counties are already constructing roads under its provisions, and that some 25 or 30 more are now seriously agitating the issuance of bonds for road construction.

While considering county road systems of this sort the question may be raised as to why the necessity of adopting a new political unit to handle road matters, rather than continuing the work under the old township or road district system. The reasons for this are many, several of which it might be well to mention.

Ten years ago the usual traveling distance for the common vehicle did not average over ten to fifteen miles per day and traffic was purely local between the farm and the trading center. Under such traffic the township system was undoubtedly adequate. Since that time, however, the automobile has been rapidly forging to the front and an inspection of the present automobile registration will show that the farmer is coming to use it as a means of getting his produce to market, as well as for pleasure. Since the automobile is so dependent upon good roads for its successful operation, one may readily understand the present and future great need of general highway improvement.

Moreover, the radius of travel for the automobile has been extended from the former ten or fifteen mile distance to distances of fifty miles and upwards; and the farmer, though still bringing his produce to the nearest trading community, often desires to visit some of his neighboring towns or even the county seat. From traffic conditions, therefore, a system of roads that will serve the county has now become essential.

Since such a system is essential, it is obvious that it must be laid out as a unit. When we come to consider 20 or 30 townships in a county attempting to handle a road proposition with an idea of unity and the aim of getting a continuous system, it is clear that the probable result would be 20 or 30 more or less independent systems, which in all probability would not join together in a satisfactory manner. In addition to this, it is not absolutely assured that the 20 or 30 townships would all cooperate at the same time; and thus, it might be that for some reason or other one or two townships near the very center of the county, and upon which might hinge a continuous through system, would refuse to cooperate. The result is apparent.

Another important feature is that with the county as a unit, uniform specifications, types of roads and methods of construction for similar conditions could be followed and the work could be handled as a unit. Also the maintenance, which is one of the most essential features of any road system, could be handled more economically and otherwise more satisfactorily. Contrast with this the system of roads laid out by 20 or 30 independent townships, each using specifications, road types and methods of construction according to its own ideas and handling its maintenance purely as a local matter, and there would appear to be no further need of contrasting the two systems on this point.

Still another factor to consider in a county system as contrasted with a township system is that the 15 to 20 per cent allowance of State aid roads in a county would mean only about 10 or 12 miles of such roads in each township, and probably not over from 5 to 8 miles to be improved. Such being the case, it would be hard to induce good contractors to

bid on the small sized jobs, whereas if the system could be laid out in sections of 20 or more miles closely connected, it would induce the best contractors to consider the work and would bring about keen competition in bidding. For this same reason the larger and more closely connected the sections of work, the more chance has the contractor to employ the most modern equipment and methods of construction, which would of course result in a lowering of the bidding price. For these many reasons, therefore, a county system of roads would seem more economical as well as more feasible.

Section 15-d of the 1915 revision of the Road and Bridge Law is as follows:

"If any county desires, more rapidly than its allotments of State aid road moneys will permit, to construct a State aid road along any one or more of its highways that have been selected and designated, under the provisions of this act, as State aid roads, such county is hereby authorized to advance, out of any county funds available from any source, or which may become available from any source, for such purpose, the entire cost of constructing such State aid roads and to make such improvement at any time. Such county shall, in such case, have the right to use any allotment of money made to it by the State Highway Commission, to defray one-half the cost of constructing new State aid roads, in the county, under the provisions of this act, or to apply the money on the payment of any bonds or other obligations which have been or may be issued by such county, under any law of this State, to meet the cost of the construction of any State aid road or roads constructed by such county at its own expense: *Provided, however*, that the allotments made by the State shall not be used to cover more than one-half the cost of the construction of such State aid roads: *And, provided, also*, that such State aid roads shall have been constructed under, and in accordance with, plans, specifications, estimates of cost and contracts approved by the State Highway Commission and which roads shall have been found, upon inspection of the State Highway Engineer, to have been completed as provided for in said contracts. All highways constructed or improved in any county under the provisions of this section shall be known as State aid roads and shall thereafter be repaired and maintained under, and in accordance with, the provisions of section 32 of this act.

"If any county desires so to advance money for the purpose of construction or improvement of its State aid roads, its county board is hereby vested with full power and authority to take all necessary steps in such case and such county board may, out of any funds in the county treasury, not required for other purposes, appropriate therefrom sufficient moneys to meet the cost of constructing or improving such State aid roads, and may also, in any manner provided by law for issuing county bonds, issue bonds of the county for the purpose of constructing or improving such State aid roads: *Provided*, that the question of issuing such county bonds shall first be submitted to the legal voters of such county at any general election or at a special election which the county board is hereby authorized to call for such purpose: *And, provided, also*, that such bonds shall be issued to mature in not less than ten or more than twenty annual series, the last series to mature not more than twenty years from date of issue. If the question of an issue of such bonds is submitted to the people, notice of election shall be given and the election shall be held and returns made, all in the manner now provided by the general election laws of this State, and the ballots shall be in substantially the following form:

Shall county bonds for roads be issued to the amount of $.....?	Yes	
	No	

"If a majority of the voters voting on such question vote in favor of the proposition the county board shall at once issue the bonds and take the necessary steps to construct or improve the State aid roads provided for. This section shall not be construed to repeal any other law on the subject of issuing county bonds, except in so far as such other law is in direct conflict herewith.

"Added by Act approved June 28, 1915."

The following from Section 9 of the Law concerning maintenance of State aid roads apply also to all work done under Section 15-d:

"*Provided, further*, that when a gravel or macadam road is constructed, the county shall pay one-half the cost of such maintenance; *and, provided, further*, that when an earth road is constructed, the county shall pay the entire cost of maintenance.

"The State pays entire cost of maintenance on a brick or concrete road."

While the foregoing gives the essence of the law relating to construction of roads by counties in anticipation of State allotments, further information as to how the law can be applied may be of value. The Law provides that a county may appropriate for road purposes out of any funds in its treasury and not required for other purposes, or may issue bonds for a sum that will not exceed 5 per cent of the assessed valuation of the county, this money to be used for the improvement of roads on State aid routes.

There is no specific reference to "a special tax of not to exceed $1 on each $100 assessed valuation for a period of not to exceed five years." This method of raising funds may be employed, however, (see Section 126 of the Road and Bridge Law) but its provisions are subject to practically the same conditions as relate to the issuance of bonds for which it is really an alternate. Therefore, references to issuance of bonds for road construction may be construed to include also the "Special tax levy." By its allotments the State will pay back to the county one-half of the actual cost of construction, but will not pay anything on the interest on bonds. When constructed in accordance with the law, such roads will be accepted as State aid roads and taken over for maintenance by the State, subject to the maintenance clause in the last paragraph of Article 9 as quoted above.

If a county desires to avail itself of this opportunity to secure a system of roads, let us now consider the steps necessary to start proceedings to vote the necessary funds, either a bond issue or special tax. In case a county has the funds actually available for such a purpose, the county board could at once proceed with getting out the plans, etc., for the work, but since no county in the State has on hand sufficient funds for a comprehensive system of roads, it is evident that a bond issue or special tax must always be a point of consideration. It is not necessary to present a petition of the taxpayers to the county board to initiate proceedings, for the proposition of voting county bonds must be determined and passed by the board and a call for election issued by them. Before the question is passed, however, the county board must actually determine the State aid routes to be improved, the types of construction and the estimated cost. They should also decide the number of series into which the bonds are to be divided, the dates of maturity of the different series and the rate of interest on the bonds. This being done, the question may be put to a vote of the people at either a special or a general election. A ma-

jority of the votes on the proposition itself is sufficient to carry the election and women are allowed to vote.

Before voting on a bond issue or a special tax proposition, there should be taken into consideration the additional yearly tax to retire the bonds or meet the special assessment, since the annual county tax rate, except by special vote of the people, shall not by law exceed 75 cents on the $100 assessed valuation.

In many instances, the present current county tax rate is closely approaching this 75 cent limit, while the tax rate to meet a twenty year bond issue at 4 to 4½ per cent interest will average about 35 cents per year.

In any case, the combined figures are readily determinable and if it is found that the limit is exceeded, arrangements must be made to submit to vote a special tax proposition in order to validate the bond issue or special tax proposition. According to the present law, the special tax proposition can only be submitted to vote at a regular election and women cannot vote on the question.

Briefly then, the foregoing places a certain restriction as to time of voting and validity of a bond issue or special tax proposition in case the yearly constitutional county tax limit of 75 cents is to be exceeded. In any case, it would be well to be sure on this point before carrying proceedings too far.

In case such a bond issue carries, it is encumbent upon the county board to proceed with the issuing of the bonds or the levying of the tax and then to proceed with the work of getting out plans and specifications necessary to carry on the construction. It has been thought by some that the State Highway Department would do this work, but the county must handle all work under Section 15-d with its own forces. The plans, specifications and estimates must be approved, however, by the State Highway Commission before the letting of contracts, and the contracts themselves must later be approved. The supervision of construction must be handled by the county and only inspection of a general character will be given by the State, although construction must at all times be satisfactory to the State Highway Commission. Upon satisfactory completion, any road built under this section of the law may be finally accepted by the commission as a State aid road and shall thereafter be maintained by the State, subject to the provisions relating to State aid roads.

Inasmuch as the usual method of a county raising money will be by a bond issue, it may be well to consider briefly the issuing of bonds as prescribed by the law. In no case can such bonds exceed 5 per cent of the equalized assessed valuation, and from this 5 per cent there must be deducted any bonded indebtedness of the county. It is further provided that bonds shall not mature in less than ten, nor more than twenty annual series, and that the last series shall not mature in more than twenty years from the date of issuance. This latter clause is generally interpreted to mean that the last series must not mature in more than twenty years from the date of issuance of the first series. When issuing a series of bonds it is usually best to figure on three or four yearly issues, inasmuch as construction work will usually not progress much faster

than this. All these factors should be borne in mind in working up any table for a bond issue.

There might be some question as to the advisability of bonding a county to the limit without considering its future financial standing and the resulting tax burden on the people. The tax rate for the county's share (one-half of the principal) and the interest on the entire series of bonds should not run more than 25 to 30 cents on the $100 assessed valuation, which in most cases is only five or six cents per acre each year on the farm land of the county. Such a figure for taxation is not unusual in securing other public utilities, and would seem, therefore, entirely feasible in the case of bonds for building a system of roads.

It should be noted that the serial bond is now considered preferable to the sinking fund bond, though the latter was formerly the most common form used. The advantages of the serial bond are many, however. Each year a certain proportion of the series is paid off and the interest stopped. Another advantage is that the bonds will mature and will be paid off before the roads are worn out, and the taxpayer each year gets a certain value received in the use of the roads for the money he pays to cancel the bonded indebtedness. With the sinking fund bond it becomes necessary to raise by taxation and set aside each year a sum of money, which with accumulated interest, will pay the principal in a certain time, and since it often happens that a good opportunity to invest this money to advantage does not present itself, there is a resulting loss to the taxpayer. Present practice shows that the serial bond is in better demand and thus brings a better price in the market.

So much having been said concerning the law and its interpretation, there yet remains to be shown how it ultimately works out. Although Section 15-d was but recently added, the counties now engaged in roadwork under it are making good progress and several miles have been satisfactorily completed and accepted. This work has invited remarkably keen competition in bidding and some very low contract prices were obtained. The method of handling the work as a county unit has proved very advantageous and a great deal of detail work has been saved the department. All plans, specifications, estimates and contracts submitted to the department have shown careful preparation and very few changes have been recommended. Of course, under such a system there is always open the objection that the county will make a poor selection of the roads to be improved and the types to be built and that the work will be poorly managed, but with the great amount of literature and general information now available concerning good road systems and types, and the usual critical nature of the people of a county toward any poor judgment or work, it would seem rather difficult to get anything but a satisfactory result.

The following summary shows the status of construction work under Section 15-d on November 1, 1916:

Two counties, Cook and Vermilion, have voted bonds for road improvement for $2,000,000 and $1,500,000, respectively. In Cook County contracts have been approved for the construction of 19 miles of Portland cement concrete and 6 miles of bituminous concrete; and additional con-

tracts for 10 miles of the former and 4½ miles of the latter will be submitted for approval at the next meeting of the commission. In Vermilion County contracts for 173 miles of brick and Portland cement concrete have been approved, and to date about 12 miles have been completed and accepted by the commission.

In 1915 a total of $258,000 in township bonds was voted in Williamson County and turned over to the county in order to take advantage of Section 15-d of the law. Contracts for 12 miles of Portland cement concrete and 6 miles of bituminous macadam have been approved by the commission and construction is under way.

Edgar County appropriated money for 2 miles of 10 foot brick road and the construction is completed and the roads accepted by the commission.

Peoria County has had plans and contracts approved for 4 miles of earth, 3½ miles of gravel and 1½ miles of brick road. This work is now under construction.

Livingston County has had plans and specifications approved for about 2 miles of bituminous macadam and contracts for same are in the office for approval. It is understood that construction will begin immediately.

Clinton County has had plans and specifications approved for 6 or 7 miles of oiled earth construction, but work will not be ready for letting until next Spring.

Piatt and Kankakee Counties have each built about one-half mile of brick road and the work has been accepted by the commission.

Edwards County has voted bonds for a system of roads, but nothing further has been done, due to the fact that the legality of the issue is in question.

Table V shows in detail the status of all the foregoing road work.

TABLE V—SHOWING PROGRESS OF ROAD CONSTRUCTION UNDER SECTION 15-d OF THE ROAD AND BRIDGE LAW TO DECEMBER 31, 1916.

County.	State aid route.	Section.	Type.	Length in miles.	Date plans and specifications approved.	Date contract approved.	Date acceptance approved.	Remarks.
Clinton	7		Earth	0.852	Aug. 3, 1916			
Clinton	9		..do	2.560	Aug. 3, 1916			
Cook	9	1	18 ft. asphaltic concrete	5.750	July 12, 1916	Aug. 30, 1916		Contract No. 3009-1. Higgins Road.
Cook	5	2-2A-2B-2C	18 ft. asphaltic concrete or 18 ft. cement	10.710	Oct. 11, 1916	Nov. 15, 1916		Rand Road. Contract let on 2C.
Cook	5 and 7		18 ft. concrete	3.120	Aug. 2, 1916	Aug. 30, 1916		Contract. No. 3005-1. Maine Twp.
Cook	20		..do	3.220	June 28, 1916	Aug. 2, 1916		Archer Av.
Cook	29	1	..do	3.825	June 14, 1916	Aug. 2, 1916		
Cook	31	1	..do	4.510	Aug. 16, 1916	Sept. 14, 1916		Rich Twp.
Cook	26,28	1	18 ft. asphaltic concrete	4.675	Sept. 27, 1916	Nov. 9, 1916		Contract 3026.1. 147th St. and 48th Av.
Cook	11	1-A	18 ft. cement-concrete	3.740	Oct. 20, 1916	Nov. 15, 1916		
Edgar	4		10 ft. brick	0.928	May 31, 1916	June 6, 1916	Oct. 18, 1916	
Edgar	7		..do	1.025	May 31, 1916	June 6, 1916	Oct. 18, 1916	
Livingston	16	1	15 ft. bit. macadam	1.014	Oct. 18, 1916	Nov. 1, 1916		Reading Twp.
Livingston	11		15 ft. bit. resurface	1.005	Oct. 18, 1916	Nov. 1, 1916		Pontiac Twp.
Peoria	1		Oiled earth	4.070	July 5, 1916	Aug. 2, 1916		Mt. Hawley Road. Contract cancelled.
Peoria	3		18 ft. mono. brick	0.530	July 5, 1916	Aug. 2, 1916		
Peoria	6		18 ft. gravel	3.410	July 28, 1916	Aug. 2, 1916		Galena Road. Contract cancelled.
Vermilion	13,11,12	1	Type A 10 ft. concrete; 3 ft. gravel or macadam shoulder	20.277	Jan. 6, 1916	Apr. 5, 1916		
Vermilion	13,2	2	Type D brick and type A concrete	20.150	Jan. 6, 1916	Apr. 5, 1916		Chicago Road. Type D brick. Rem. type A concrete.
Vermilion	15,11	3	Type A concrete	18.120	Jan. 6, 1916	Apr. 5, 1916		
Vermilion	2,3,15	4	Type D brick and type A concrete	16.770	Jan. 6, 1916	Apr. 5, 1916	2.75 miles Oct., 1916	Chicago Road. Type D brick. Remainder type A concrete.
Vermilion	15,11,10	5	Type A concrete and brick	18.670	Jan. 6, 1916	Apr. 5, 1916		
Vermilion	9,9A,19	6	Type D 10 ft. brick and type A, 10 ft. concrete	17.881	Jan. 6, 1916	Apr. 5, 1916		Type D, 10 ft. brick east of Oakwood. Remainder type A 10 ft. concrete.
Vermilion	7,8,18	7	..do	18.973	Jan. 6, 1916	Apr. 5, 1916	3.13 miles Nov. 1, 1916	Type D, 10 ft. brick east of Catlin. Remainder type A, 10 ft. concrete.
Vermilion	18,7,17,18A	8	Type A, 10 ft. concrete	19.909	Jan. 6, 1916	Apr. 5, 1916	4.81 miles Nov. 1, 1916	
Vermilion	7,6,6A,16	9	Type D, 10 ft. brick and type A, 10 ft. concrete	22.523	Jan. 6, 1916	Apr. 5, 1916	0.50 miles Nov. 1, 1916	Type D, 10 ft. brick north of Georgetown. Remainder type A, 10 ft. concrete.

TABLE V—Concluded.

County.	State aid route.	Section.	Type.	Length in miles.	Date plans and specifications approved.	Date contract approved.	Date acceptance approved.	Remarks.
Williamson...	8	D and O	10 ft. concrete	2.755	July 19, 1916	Aug. 16, 1916	1.00 mile Dec. 20, 1916..	
Williamson...	10	E	15 ft. concrete	1.690	June 7, 1916	June 28, 1916		
Williamson...	9	F	10 ft. concrete	1.175	June 7, 1916	June 28, 1916		
Williamson...	1	G	..do	1.250	July 12, 1916			
Williamson...	1A and 1	H and N	15 ft. bit. macadam	5.600	Aug. 16, 1916	Aug. 16, 1916		
Williamson...	4	I	10 ft. concrete	1.480	July 19, 1916	July 19, 1916		
Williamson...	1	J	..do	1.025	July 19, 1916	Sept. 28, 1916		
Williamson...	9	K	12 ft. concrete	1.013	Sept. 27-28-16	Sept. 28, 1916		
Williamson...	14	Q	10 ft. concrete	1.484	July 19, 1916	Sept. 27, 1916		
Williamson...	10	R	..do	1.646	Aug. 16, 1916	Sept. 28, 1916		
Williamson...	13	P	..do	1.126	No record	July 19, 1916		
Piatt.....	6	B ext.	9 ft. mono. brick	0.208	July 27, 1915	Apr. 26, 1916		
Kankakee....	15	E	2-10 ft. brick	0.135	Aug. 17, 1915	Oct. 12, 1915		

It now remains to explain what the State Highway Department has done in the way of assisting the counties in carrying out the provisions of this section of the law. Early in the year 1916, the department began to receive from various counties calls for assistance in promoting bond issues and for information relative to the steps necessary to pass the required resolutions. Up to the present some thirty to forty counties have requested information. In many cases this has simply meant a visit by a member of the State Highway Commission or the Chief State Highway Engineer. At such meetings held by the local good road clubs, or at the instigation of the county boards, the general features of a bond issue have been discussed and ways and means of procedure talked over. Often such meetings have lead to nothing further, but generally, other meetings have followed and local committees have been appointed.

In a number of cases the department has been asked to furnish preliminary engineering assistance. In these cases the usual practice has been to work up a number of charts and maps, to make approximate estimates of the costs per mile of various types of roads and to actually lay out several tentative road systems, meeting the requirements of the county in question.

The method of handling this work will be discussed in detail a little further on. This information is intended as preliminary only, and is submitted to the county superintendent of highways, or the special committee appointed by the county board, not with the idea of its being used as a final solution of the problem, but merely in order to get the committees started along the right lines and to get them familiar with the selection of a well balanced system of roads, it being desired that each county shall work out its own final scheme. The presentation of this preliminary information has called for a number of meetings with the county officials, and in many cases the local committee has called upon the department for further advice in working up a system it has suggested. Several counties have worked up very satisfactory systems of their own, by special committees and the assistance of their county superintendents, and a number of others have reached the point where all details have been worked out and the proposition has passed the county board and a date of election set.

Figure 14 shows the present status of this phase of the bond issue work throughout the State, and also those counties in which the State Highway Department has furnished assistance. Speakers have been furnished for a large number of "booster meetings," especially in those counties that have decided upon a bond issue election.

For the information of counties contemplating bond issues it would be well to outline in some detail the method in which the improvement of a system of roads has been considered, together with the selection of the types to be used. The State aid system as laid out is usually made up of more roads than can be improved with the money available. It is always a question, therefore, of selecting the primary roads of the State aid system. This is best done by the process of elimination, selecting the most important roads first and then deciding upon the proper types of pavements for them. This method of selection should be carried on

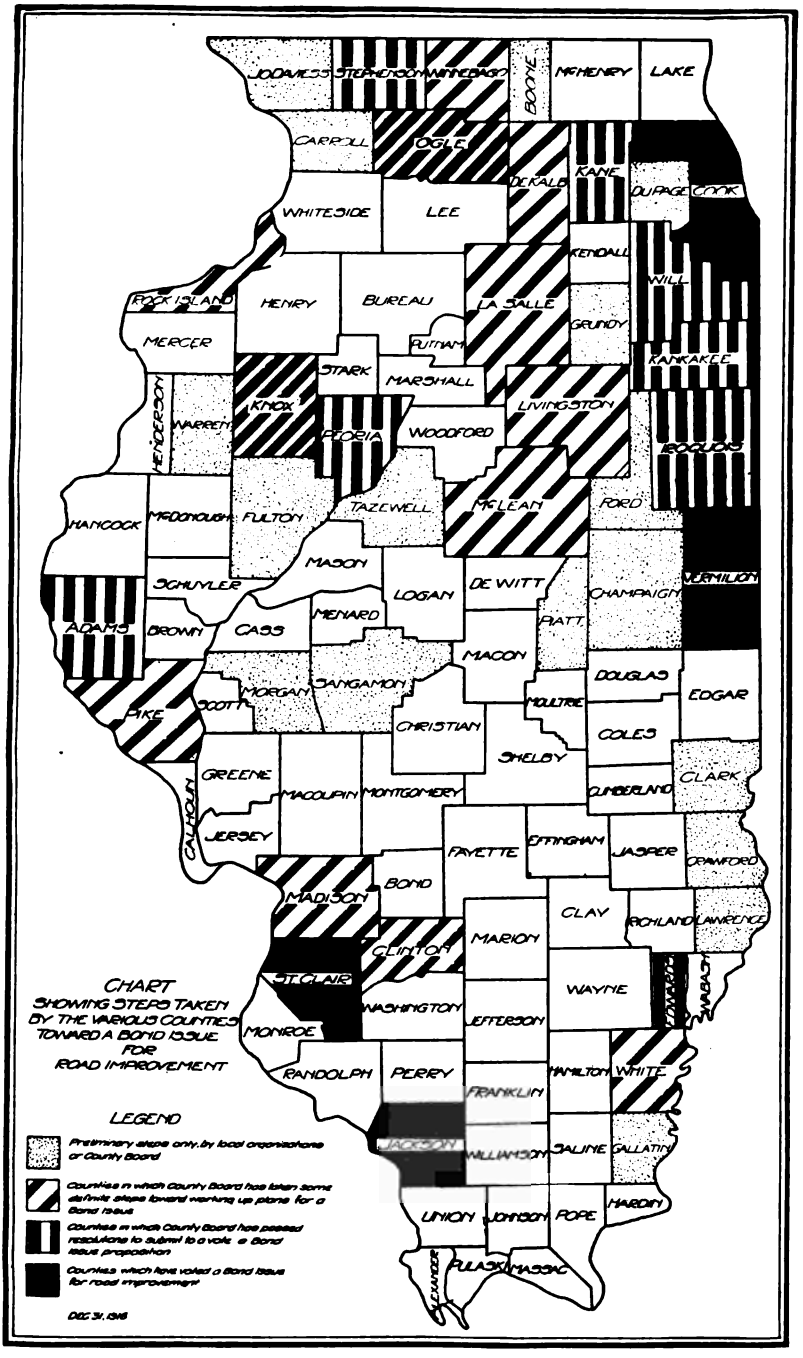


Fig. 14. County road systems.

as far as the funds available for construction will permit and the result should be a system of primary State aid roads with types of construction that satisfy the traffic and other requirements.

In working up a system along these lines the selection should be made by considering several factors, such as the geographical distribution of the population and of the assessed valuation of property; the traffic census, which shows essentially not the absolute amount of traffic, but rather the relative amounts on the several roads; the inter-relation of roads in adjacent counties with respect to the above mentioned factors; the through routes and trails; and the topographic conditions. Figure 15 shows a map worked up on the basis of the first of these factors. Figures 16 and 17 show a typical traffic census sheet and a traffic census map. The fourth and fifth factors may be readily determined by the examination of maps of adjacent counties and a map showing through routes and trails.

The topographic conditions to be considered in the selection of a system of roads must often be temporarily disregarded, for at the time of working up the preliminary scheme one cannot be sufficiently familiar with the conditions attending the particular routes concerned. The first two factors are usually reliable criterions for general guides, as there is nearly always an intimate relation between the amount of traffic and the population and assessed valuation in the same vicinity. While the traffic census will in most cases show what is intended, yet it should not be given too much weight, since the particular location of the road and the fact of its unimproved condition might tend for very small traffic readings, whereas if the road were improved the traffic would be materially increased.

The matter of inter-county through routes is of considerable importance, though often such routes may be altered somewhat to fit the first two factors without making any material difference, inasmuch as through traffic is generally of such a kind as not to be inconvenienced by a few extra miles. Topographic considerations may at times warrant slight changes in the routes selected with reference to the other factors, but as mentioned, little is known concerning such features in the preliminary work.

The types of roads selected for any system should be such as will most satisfactorily fit the traffic conditions and at the same time, come nearest being the most economical in point of ultimate cost. A balanced system of roads can be likened to a tile drainage system, in which no one would think of using all one size pipe, but would use, say, a 24 inch size as a discharge pipe, with some 12 inch feeding into this main and then 8 inch and 6 inch tile feeding into the 12 inch. A system of roads is very similar, since leading to some objective point there is always one main traveled road into which lead a number of secondary roads, and into these in turn lead the small feeders. This should be borne in mind in selecting the types of improvements, for to build an 18 foot brick pavement on a road having only 50 ordinary vehicles a day, would be just as much an error as to build a 10 foot gravel or macadam road for 800 vehicles per day.

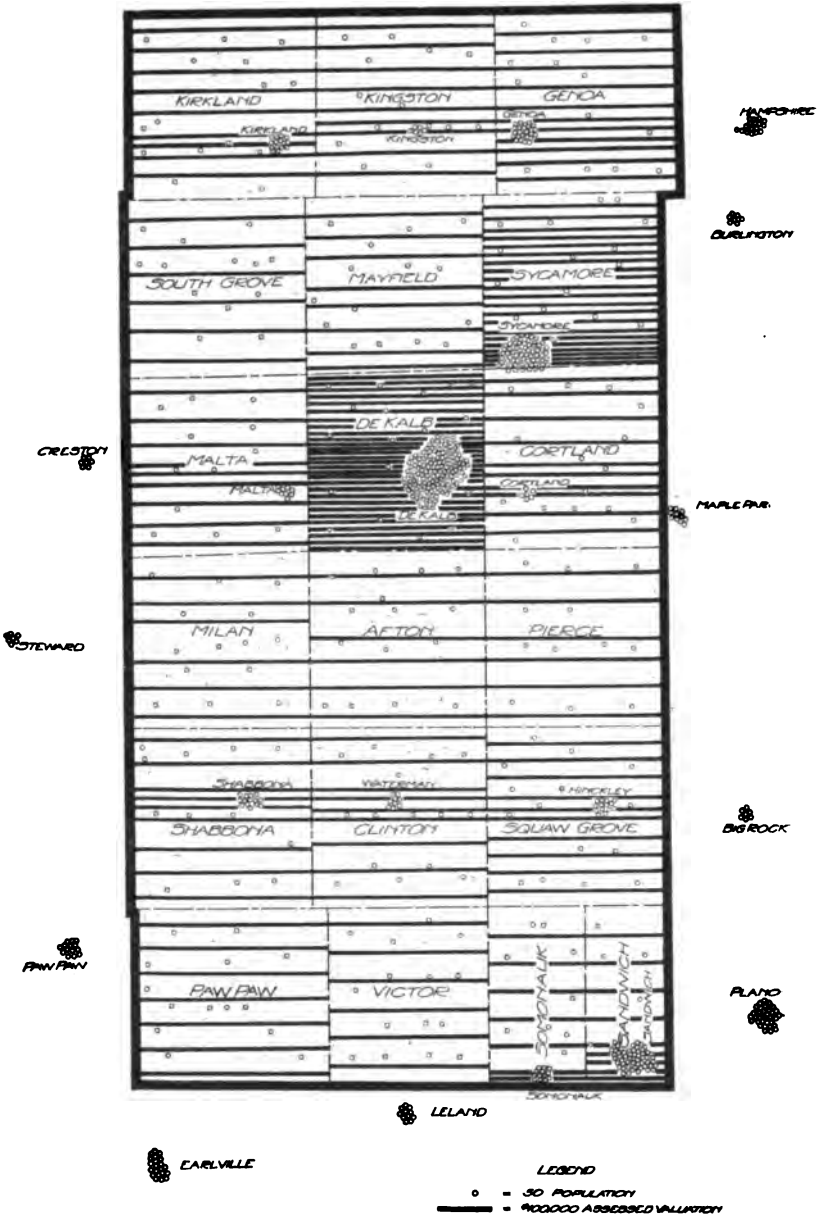


Fig. 15. County road systems.

STATE OF ILLINOIS, STATE HIGHWAY DEPARTMENT, TRAFFIC REPORT.

Station No.....
Location of Station..... For.....County.
Clear: Cloudy; Showers.....
Temperature: 7 a. m..... 6 p. m.....

Date.....
.....
Signature of Observer.

H 4

KIND OF VEHICLE.		A. M. 7-8	8-9	9-10	10-11	11-12	P. M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	TOTALS.
HORSE DRAWN VEHICLES.	|															
	–															
	⌟															
	⌞															
	⌝															
	⌜															
MOTOR VEHICLES.	|															
	–															
	⌟															
	⌞															
	⌝															
	⌜															
Total.....																

EXPLANTORY NOTE:—Lines in second column indicate line of travel. Thus (|) may indicate North and South traffic, and accordingly (–) will indicate East and West traffic, whereas (⌟), (⌞), (⌝) and (⌜) indicate traffic around what particular corner. (See Diagram).

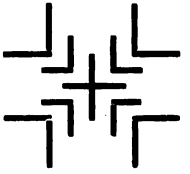


Fig. 16.

Form 160

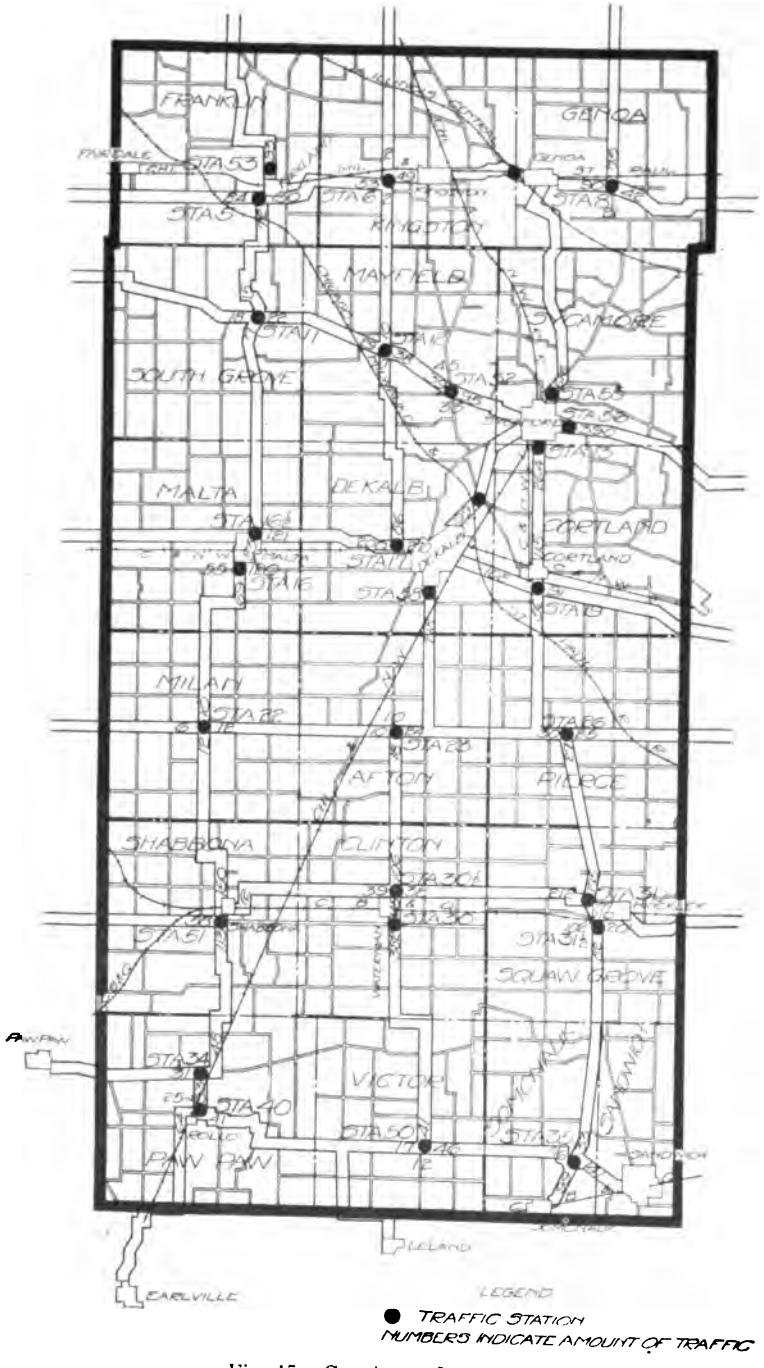


Fig. 17. County road systems.

Another feature of prime importance is the ultimate costs of the various types of roads extended over a long period of years, and the selection of types should never depend upon the construction cost alone, but rather upon three costs, namely: the construction cost, which is the original expense in getting the improvement made; the interest cost, which is the amount that must be paid for interest on the money borrowed to build the work; and the maintenance cost, which is the necessary expense year after year in keeping the improvement up to the standard that could reasonably be expected of the particular types in question.

An example will illustrate the point more clearly. Let us assume a road that will cost $8,000 per mile to build, and, with just ordinary maintenance when needed, will last for twenty years. If the money to build the road is raised by bond issue, the interest for a twenty year period will amount to about 40 per cent more, or $3,200. Let there be assumed a maintenance cost of $100 per year, or $2,000 for the twenty year period. These will give the total cost of the road at the end of twenty years as $13,200.

Now assume another type of road that will cost $5,000 to build, but which will need a new wearing surface at the end of eight years. The first, or construction cost, is $5,000 and the interest on this for the twenty year period would be $2,000. Assuming maintenance at the rate of $200 a year, we have $1,400 for seven years. At the end of the eighth year the road must be resurfaced at, let us say, a cost of $2,700, or about 50 per cent of the original cost of construction. Interest will not be figured on this last amount. With the road lasting eight years longer, the maintenance will be another $1,400. This will take the road to the sixteenth year when another $2,700 will be necessary to resurface it. The maintenance work through the twentieth year will then be $800. Totaling these several expenses, we find the road to have cost $16,000. Comparing this with the first example, the conclusion is obvious.

On the other hand, an example in which the resurfacing cost at the end of eight years is only $1,600 and the maintenance $100 per year, would give for the cheaper road a total of about $12,000 for a twenty year period. By analyzing the costs of the various types of roads in this manner it becomes evident which is the cheapest in the long run. Of course, if two types are very close in their ultimate costs we must bear in mind the inconveniences due to the extensive maintenance, and also the two or three renewals required on the cheaper road. In other words, the higher type of road in such a case would be preferable, as it would need less attention for the twenty year period and would provide a satisfactory pavement rather than a series of renewals.

There is often advanced the idea that if a brick or concrete road is built the State will take it over for maintenance, whereas on other types the county must bear at least a portion of this cost. Except for the fact that the State would probably be able to organize and keep up a more perfect system of maintenance work, this feature of the law should not enter into the consideration, for the taxpayers sooner or later furnish

the money for the maintenance, whether the State or the county administers it.

Another matter for consideration in the design of a system of roads is the availability of local materials. Not only should the specifications be open for the admission of all such materials that are reasonably satisfactory, but in addition, the selection of the types of roads to be built should be greatly influenced by the very presence of these materials. Into a locality abounding in local gravel or stone of only a medium quality, it would not be good business to ship from a distance stone for a macadam road. If local material, costing about 50 per cent of shipped-in material, can be utilized with any efficiency greater than 50 per cent as against the latter, it is evident that good business procedure would demand its use. Where there are local materials an endeavor should usually be made to utilize them in some manner, even though the specifications may need modification to admit them.

Still another feature for consideration is the local topography and the present condition of the roads. For instance, a road may already have three or four inches of macadam or gravel surfacing that could well be used as a base course for macadam resurfacing, or perhaps with a little shaping up, as a base for a brick pavement. In such cases, it might be more economical to resurface with macadam bound with some bituminous compound, rather than tear up the entire road to build a concrete surface; or even a satisfactory brick road might be built by utilizing the old macadam as a base and thereby keeping the total cost as low as that of a concrete surface.

The topography and the character of the soil on each particular section of the roads should also be taken into consideration, for at times the selection of the proper type will hinge upon these factors. For example, a low swampy land with a uniformly treacherous subsoil may safely support a rigid concrete road, but cause a gravel or macadam to fail entirely. Also on hillsides subject to wash a gutter may be an economic necessity; and again, on steep grades a hillside brick might be required.

The same reasoning as regards the selection of types would hold also for the width of graded roadway. The width of metaled way, however, is governed almost entirely by the amount and the character of the traffic.

After having carefully considered all these factors, a satisfactory system of roads would perhaps be laid out and the next step would be to make approximate estimates of the cost of each type. After making these estimates it is often found that the cost is in excess of the money available. Under these conditions either of two courses are resorted to: reduce the size of the system to meet the available funds, or use less expensive types for those roads nearly on the dividing line as to ultimate cost. For example, a 150 mile system made up almost entirely of concrete and brick might be reduced to 100 miles of these types, leaving out 50 miles of the lesser important routes in the improvement; or again, by using lower types for 75 miles there may be enough saved in the construction cost to enable the other half of the system to be built of concrete and

brick. The 75 miles could be improved with gravel or macadam without interfering seriously with the original idea as regards a proper design, for these roads would in all probability be the least traveled ones, and, consequently, those on which the maintenance would be least. In other cases it might be more feasible to limit the work on certain roads merely to the grading and permanent culverts, with the idea of putting such roads into shape for a hard surface later on. This method might be especially applicable to a system where a fixed mileage must be improved, but where it would not be advisable to change from a high type of hard road to a lower type in order to get the mileage required for a given expenditure. By this plan the pavements laid would be of the desired types and the remaining mileage would have a seasoned foundation for future improvement.

There are also many of the poorer counties where available funds would be so limited that the only way to get any system of improved roads at all would be to confine the entire work to the building of permanent culverts and doing such grading as would assure satisfactory drainage on the bottom lands and the reduction of hills in the uplands. Such a system would give a good type of earth road and would provide a settled and seasoned road-bed for a future system of hard roads.

In making up estimates for preliminary work, care should be taken that they are high enough to cover all reasonable contingencies, for it is easier to explain a reduction than to apologize for an increase in cost. One should take into consideration also the possibility of grouping the sections in such a way as to let as large contracts of one type of improvement as practicable.

Figures 18 and 19 are typical estimating sheets and curves showing the relative approximate costs of various types of improvements for a one mile haul of materials.

Figure 20 shows a typical system of roads laid out for DeKalb County. This system is merely a suggested rather than a recommended one.

If the foregoing considerations are given due attention in evolving a system of roads for a county it is believed that the systems will be well balanced, and the average committee of the county board can design such a system with the engineering assistance of the State Highway Department at its disposal.

ESTIMATES OF COST PER MILE OF VARIOUS TYPES OF ROADS AS PROPOSED FOR DEKALB COUNTY.

Type.	1 mile haul.	2 mile haul.	3 mile haul.	4 mile haul.	5 mile haul.
Concrete—					
10 ft. pavement	$7,037	$7,543	$8,103	$8,626	$9,151
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$8,987	$9,493	$10,053	$10,576	$11,101
15 ft. pavement	$10,780	$11,590	$12,454	$13,274	$14,093
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$12,730	$13,540	$14,404	$15,224	$16,043
18 ft. pavement	$13,330	$14,325	$15,430	$16,460	$17,489
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$15,280	$16,275	$17,380	$18,410	$19,439
Brick—					
10 ft. pavement	$11,395	$12,022	$12,706	$13,366	$14,004
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$13,345	$13,972	$14,656	$15,316	$15,954
15 ft. pavement	$16,931	$17,862	$18,869	$19,845	$20,788
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$18,881	$19,812	$20,819	$21,795	$22,738
18 ft. pavement	$20,896	$22,081	$23,367	$24,610	$25,809
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$22,846	$24,031	$25,317	$26,560	$27,759
Macadam—					
10 ft. pavement	$4,269	$4,790	$5,350	$5,888	$6,392
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$6,219	$6,740	$7,300	$7,838	$8,342
Local material, total cost	.....	.....	.....	.....	.....
15 ft. pavement	$6,416	$7,190	$8,031	$8,841	$9,590
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$8,366	$9,140	$9,981	$10,791	$11,540
Local material, total cost	.....	.....	.....	.....	.....
Gravel—					
10 ft. pavement	$3,233	$3,662	$4,143	$4,606	$5,069
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$5,183	$5,612	$6,093	$6,556	$7,019
Local material, total cost	.....	.....	.....	.....	.....
15 ft. pavement	$4,836	$5,477	$6,192	$6,883	$7,574
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$6,786	$7,427	$8,142	$8,833	$9,524
Local material, total cost	.....	.....	.....	.....	.....

ASSUMED PRICES FOR MATERIALS.

Bitumen, per gal	$0.10	Local pit run gravel	$1.00
Brick, per sq. yd	0.80	Sand	1.03
Cement	1.24	Macadam stone	1.20
Teams	0.50	Macadam screenings	.....
Labor	0.25	Local macadam	.....
Washed gravel	1.00		

Fig. 18. County road systems.

ESTIMATES OF COST PER MILE OF VARIOUS TYPES OF ROADS AS PROPOSED FOR DEKALB COUNTY.

Type.	1 mile haul.	2 mile haul.	3 mile haul.	4 mile haul.	5 mile haul.
Bitumen concrete—					
10 ft. pavement	$7,313	$7,885	$8,457	$9,029	$9,601
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$9,263	$9,835	$10,407	$10,979	$11,551
15 ft. pavement	$10,864	$11,714	$12,564	$13,414	$14,264
earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total	$12,814	$13,664	$14,514	$15,364	$16,214
Bitumen macadam—					
10 ft. pavement	$5,813	$6,344	$6,918	$7,470	$8,022
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$7,763	$8,294	$8,868	$9,420	$9,972
15 ft. pavement	$8,928	$9,721	$10,514	$11,307	$12,100
Earthwork and culverts	1,950	1,950	1,950	1,950	1,950
Total cost	$10,878	$11,671	$12,464	$13,257	$14,050
*Resurface bitumen macadam—					
10 ft. pavement	$3,475	$3,682	$3,889	$4,096	$4,303
Earthwork and culverts	750	750	750	750	750
Total cost	$4,225	$4,432	$4,639	$4,846	$5,053
15 ft. pavement	$5,208	$5,518	$5,828	$6,138	$6,448
Earthwork and culverts	750	750	750	750	750
Total cost	$5,958	$6,268	$6,578	$6,888	$7,198
*Resurface gravel and macadam—					
10 ft. pavement	$1,932	$2,130	$2,328	$2,526	$2,724
Earthwork and culverts	750	750	750	750	750
Total cost	$2,682	$2,880	$3,078	$3,276	$3,474
15 ft. pavement	$2,895	$3,189	$3,483	$3,777	$4,071
Earthwork and culverts	750	750	750	750	750
Total cost	$3,645	$3,939	$4,233	$4,527	$4,821

NOTES.—These estimates have been made by the Illinois State Highway Department in accordance with its standard specifications.

The earthwork noted above includes a nominal amount of cut and fill, shaping earth shoulders, and small culverts to the amount of $500.00.

Heavy earthwork and large culverts or bridges must be figured extra.

* Earthwork noted on resurfacing estimates included shaping earth shoulders only.

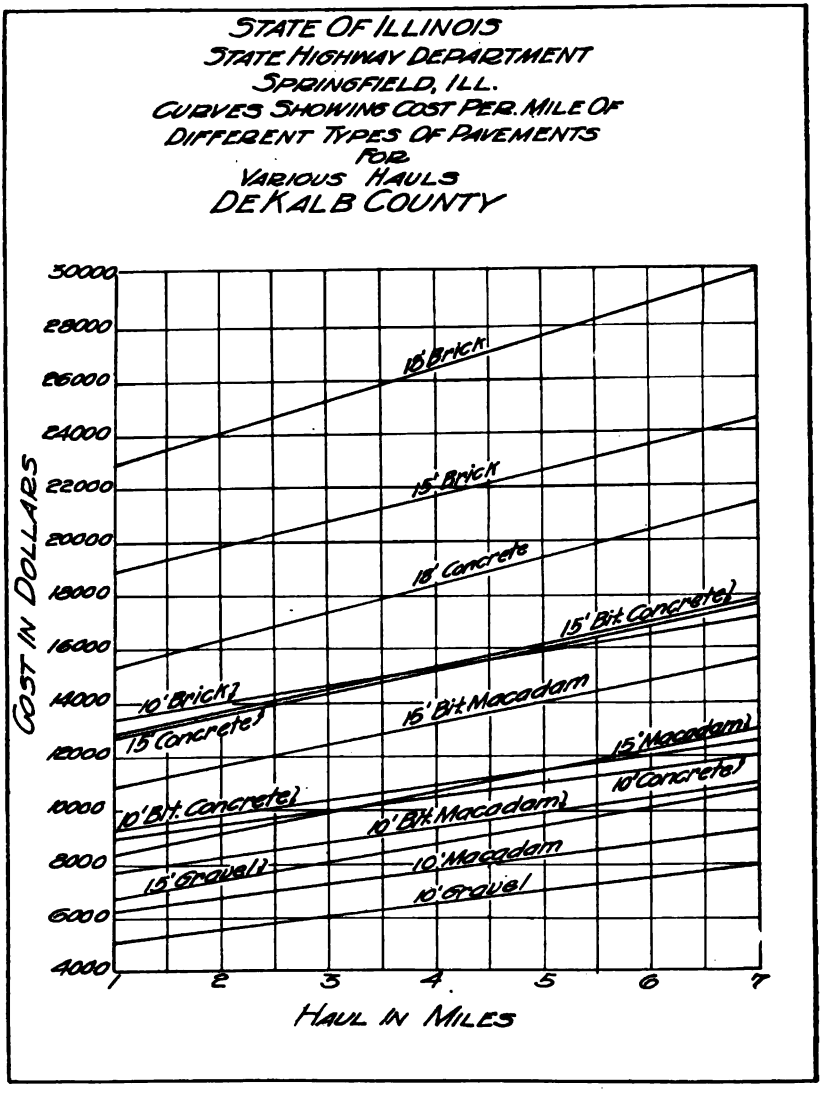

STATE OF ILLINOIS
STATE HIGHWAY DEPARTMENT
SPRINGFIELD, ILL.
CURVES SHOWING COST PER. MILE OF
DIFFERENT TYPES OF PAVEMENTS
FOR
VARIOUS HAULS
DE KALB COUNTY
COST IN DOLLARS
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
1
2
3
4
5
6
7
HAUL IN MILES
18' Brick
15' Brick
18' Concrete
15' Bit. Concrete
10' Brick
15' Concrete
15' Bit. Macadam
15' Macadam
10' Concrete
10' Bit. Concrete
10' Bit. Macadam
15' Gravel
10' Macadam
10' Gravel

Fig. 19.

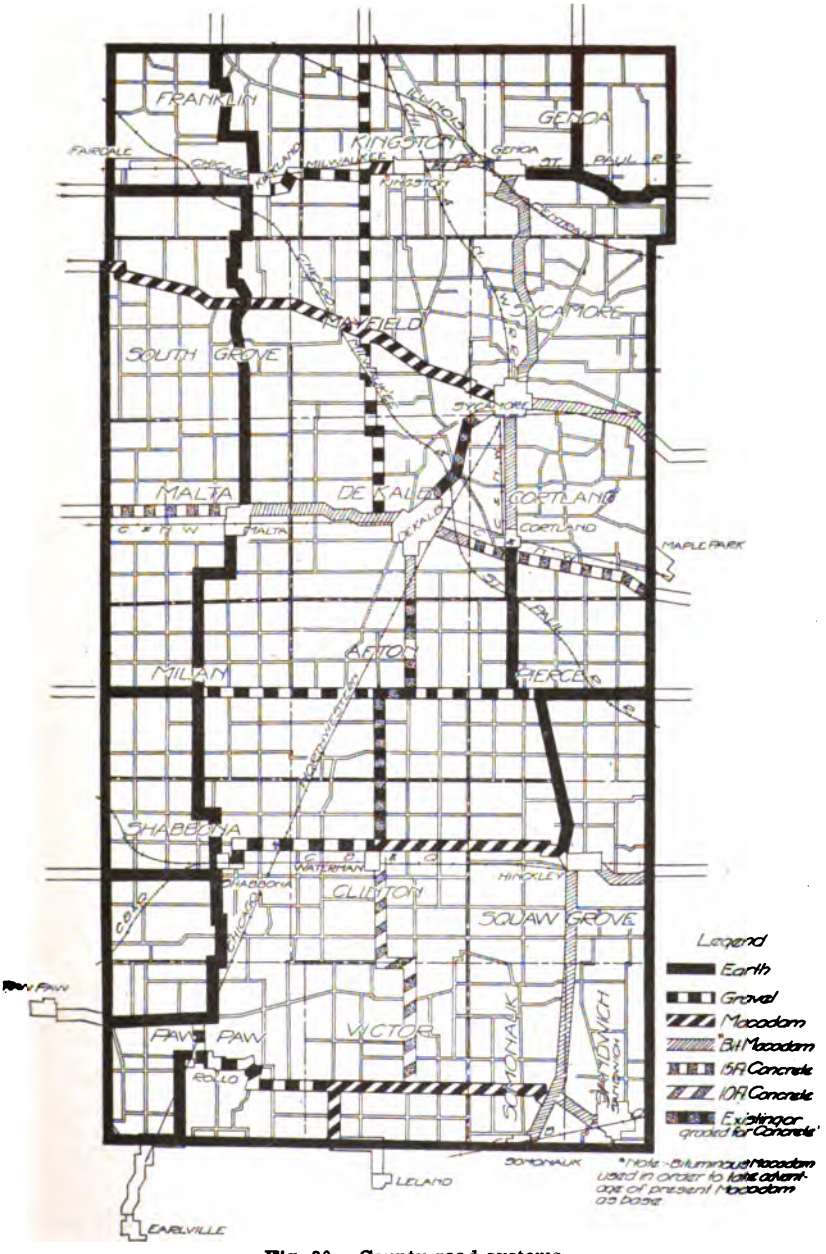


Fig. 20. County road systems

PART II

Bureau of Bridges

REPORT OF BUREAU OF BRIDGES.

(CLIFFORD OLDER, Bridge Engineer.)

On July 1, 1913, the act "to revise the law in relation to roads and bridges" went into effect.

This law provides for many important changes from the old law in regard to the administration of highway work. Many of these changes apply particularly to the construction of highway bridges.

Briefly, the State Highway Commission and Chief State Highway Engineer, under the law providing for a new State Highway Department, have immediate and complete control of the construction and maintenance of all highway bridges built as State aid improvements.

They exercise also, almost as complete control over certain other bridges, by virtue of the fact, that the plans and specifications must be submitted to the State Highway Commission for approval. All bridges constructed at the entire expense of one or more counties or at the expense of a county and one or more townships, fall under this head. Such bridges constitute a large proportion of the more important structures, as the various counties are required, by law, to build all county line bridges, to pay one-half the cost of all other bridges, when the cost of the individual structures exceeds twelve cents on the one hundred dollars of the assessed valuation of the township or road district in which the structure is located, and in addition are given the option of building any bridge, regardless of cost or location, in the county.

The State Highway Commission also exercises indirect control over all township bridges which cost individually more than two hundred dollars. This follows from the provisions of the law which require that all township contracts, exceeding two hundred dollars in amount, must be approved by the county superintendents of highways, who in turn are required to conform to rules and regulations formulated by the State Highway Commission.

It is to be noted that, the State Highway Commission exercises complete control over both design and construction of bridges built as State aid improvements; complete control of the preparation of plans and specifications, but not of construction for county and county aid bridges, and only indirect control of township bridges costing over two hundred dollars. The construction of county and county aid bridges is under the immediate control of the county superintendents of highways. In turn the county superintendents of highways have control over bridges constructed at township expense only through their power of veto over contracts amounting to more than two hundred dollars.

In general, this plan of operation has resulted in a very marked improvement in the character of the highway bridges constructed. As by far the greater part of the bridge work now falls directly or indirectly under the control of the county superintendents of highways, they perform an exceedingly important part of highway administrative matters from the point of view of highway bridge construction alone.

As might be expected, the character of the bridge work built in the various counties is largely a reflection of the character and ability of the county superintendents of highways.

Under the revised law the county superintendents of highways are required to prepare plans and specifications for all bridges built by a county or jointly by a county and one or more townships, or they have the option of calling upon the State Highway Commission for such plans and specifications.

It might be expected then, that the amount of work handled by the Bridge Bureau of the State Highway Commission would reflect the operation of the law in the number of requests for the preparation or approval of bridge plans.

The inevitable delay in the appointment of the county superintendents of highways, and the time necessary for them and highway officials in general to become familiar with, and to put into operation, the new provisions of the law, as might have been expected, resulted in but a slight increase in the number of bridges designed by the State department in 1913 and 1914.

The increase during the years of 1915 and 1916, however, is very marked.

It has been impossible, especially during the months of April, May and June to handle all requests for bridge plans and specifications as promptly as necessary to secure the best results; the work at times being a month and sometimes considerably greater periods, behind the requests. This has been due largely to the lack of funds with which to carry on the work, but partly, also, because of the fact that engineers experienced in highway bridge design are few. It has, in fact, proved the best policy to employ inexperienced men and by gradually increasing the importance of the work assigned to them, eventually develop the specialized knowledge which is essential.

GENERAL CONDITION OF HIGHWAY BRIDGES.

It is believed that the bridge survey made by the county superintendents of highways in 1914 and reported to the State Highway Department affords reliable information in regard to the character, total number and length of the drainage structures which exist in Illinois outside of the corporate limits of cities and villages.

The tabulated results of this survey represent one-half of the total road mileage of the State and include large areas of all classes of topography. These results make possible a reasonably accurate estimate of totals for the entire State.

Table I is a summary of the results of the survey.

The tabulation covers the bridges found on 48,426 miles of road. As the entire road mileage of the State is practically double this figure, the last column of the table represents closely the total number of structures of each class in the State.

TABLE I.

Type.	Number of bridges more than 60 feet long.	Number of bridges 9 to 60 feet long, inclusive.	Number of culverts less than 9 feet long.	Total on 48,426 miles of road.	Total in State.
Concrete and stone	51	2,379	7,570	10,000	20,000
Steel on masonry foundations	775	5,076	1,372	7,223	14,446
Steel leg and tube bridges	697	6,329	1,632	8,658	17,316
Wood on masonry foundations	73	1,139	1,101	2,313	4,626
Wood throughout	118	6,424	27,692	34,234	68,468
Corrugated pipe	.....	.....	17,811	17,811	35,622
Plain steel pipe	.....	.....	3,308	3,308	6,616
Cast iron pipe	.....	.....	1,603	1,603	3,206
Vitrified tile pipe	.....	.....	12,813	12,813	25,626
Total number	1,714	21,347	74,902	97,963	195,926
Total length in feet	168,328	396,639	205,038	770,005= 145.9 mi.	1,540,010= 291.8 mi.

From the above tabulation, the following may be derived:

Number of bridges per mile of road	2.12	
Average length of bridge per mile of road	16.46	feet
Average length of each bridge	7.76	feet
Bridges over 60 feet long	1.8	per cent
Bridges between 9 and 60 feet long	21.8	per cent
Bridges under 9 feet in length	76.4	per cent

Classified in accordance with type of construction:

Wood throughout	34.9	per cent
Corrugated pipe	18.2	per cent
Vitrified tile pipe	13.0	per cent
Concrete and stone	10.1	per cent
Steel tube and leg	8.8	per cent
Steel on masonry	7.2	per cent
Steel pipe	3.8	per cent
Wood on masonry	2.3	per cent
Cast iron pipe	1.7	per cent

PROBABLE FUTURE BRIDGE EXPENDITURES.

From the above it may be seen that at the beginning of 1915 more than one-third of our highway bridges were wood structures, and as the average life of an ordinary wood bridge can not be considered as more than ten years, we must face the problem of rebuilding all of these structures during the next ten years.

The records of the State Highway Department indicate that the average life of steel bridges on tube, post and leg foundations, is not more than fifteen years.

The life of corrugated iron pipe, plain steel pipe, and tile pipe may be assumed as ten years.

The life of steel bridges on masonry foundations should be not less than about fifty years. Iron and steel bridges on good masonry foundations, forty to fifty years old, are reasonably common.

The number of stone and cast iron structures is so small and their life is so great that they may be disregarded.

By far, the greater portion of the 20,000 structures listed as concrete and stone, are reinforced concrete bridges and culverts, built during the last ten yeas.

Having then based an assumed life for other types of structures upon fairly extensive data, if we now assume that the comparatively new concrete structures may not be expected to require renewal during the next ten years, we may make a fairly reasonable estimate of the necessary annual bridge expenditure during and at the end of a ten year period.

In the following table, the total number of drainage structures of each class is given, also the estimated average length of life of each class and the resulting probable number of renewals necessary per year for the next ten years.

TABLE II.

Class.	Total number in Illinois.	Estimated average life (years.)	Number of renewals per year for the next ten years.
Steel on masonry foundations	14,446	50	289
Steel on steel tubes, posts and legs	17,316	15	1,15
Corrugated pipe, plain steel pipe, tile pipe	67,884	10	6,786
Wood superstructures and wood throughout	73,094	10	7,30
Total			15,538

It will be noted that the estimated number of renewals per year for the next ten years is about 15,500 structures of all sizes and types. This is about 8 per cent of the total number of highway drainage structures in the State.

The bridge survey reports from which the above tables were compiled, called for data in regard to the number of structures needing replacement at the beginning of 1915. This data indicated, that of the total number examined, 17,000 or 8.7 per cent needed replacement. This furnishes a rough check on the life estimates for the various types of structures given above which resulted in an estimated annual removal of about 15,000 or 8 per cent of all drainage structures each year for the next ten years.

The present price of bridge materials (December, 1916) cannot be considered normal, and it would not be fair to estimate expenditures for the next ten years at present prices. From the records of cost of structures designed by the State Highway Department, were selected numbers of structures of various lengths in the proportion of lengths shown by the survey data. From these records, the average cost of the average length bridge under normal conditions, was found to be about thirty-five dollars per foot.

The average bridge which is 7.76 feet long would cost then about two hundred seventy-two dollars. If then each of the 15,500 structures

which may be expected to require renewal each year for the next ten years is replaced by a modern structure, we must plan on expending for bridge renewals alone, about $4,200,000 each year, or $42,000,000 for the ten year period.

From data available, it appears that our present annual bridge cost, including repairs, is about four million dollars per annum, the greater part of which now goes for structures of the most substantial type.

It might seem at first sight that the rapid replacement of short life structures with others of much more durable character, would soon materially lessen the annual bridge expenditure. This will no doubt be true to a certain extent. We can hardly expect, however, to build more than an average of about 15,000 modern structures each year, as for some time it will be necessary to use a part of the funds available, for the repair of structures not yet ready for renewal.

The survey mentioned, indicated that at the beginning of 1915 as many bridges and culverts were in need of repair as those in need of replacement. Moreover, the wood and other short life structures now in existence are of all ages and we may therefore expect a nearly uniform number will require replacement each year, until they have all been reconstructed. Considerable relief should be felt, however, at the end of ten years when the wood bridges will have practically disappeared.

Under the revised law, it is a certainty that the character of construction will continue to improve rapidly, so that we may be justified in making a rough prediction of the annual bridge expenditure ten years hence.

It is more than probable that a large proportion of all short life structures will have been replaced with concrete or structural steel bridges of proper design by 1925. An indication of the present tendency is shown by the fact that about 90 per cent of all structures designed by the Illinois Highway Department are reinforced concrete.

Assuming then, that an average of about 15,000 modern structures will be built each year for the next ten years, and that 90 per cent of these will be reinforced concrete, and the balance of such construction, that the expected life may be fifty years, there will have been constructed about 136,500 concrete and 13,500 other bridges.

The bridges of each class then existing may be estimated roughly as follows:

Concrete, reinforced concrete and stone (new and old)	156,500
Steel on masonry foundations (4/5 of present number + 13,500 new structures)	25,000
Steel on steel tubes, posts and legs (1/3 of present number)	6,000
Cast iron pipe	3,500
Miscellaneous	5,000
Total	196,000

Assuming that the bridges existing in 1925 may be approximately classified as above, that concrete and similar bridges and cast iron culverts depreciate 1 per cent per annum; steel bridges on masonry foundations 2 per cent per annum; steel on steel tubes, posts and legs, 7 per

cent per annum; and the miscellaneous structures 10 per cent per annum, the annual replacements would be about as follows:

Concrete, stone, etc.	1,600
Steel on masonry foundations	500
Steel, on steel tubes, etc.	600
Miscellaneous	500
Total	3,200

If we assume that the average length of these structures will be double the average length of all the bridges, and the cost per foot, 50 per cent more than the normal cost previously figured, the average renewal cost would be about eight hundred dollars per bridge, or a total of about $2,500,000 per annum for all renewals. This is about one-half of the present annual expenditure for this purpose.

It may seem unduly optimistic to estimate that 90 per cent of all bridges renewed during the next ten years will be constructed of reinforced concrete or other equally durable material. It is quite probable that for a few years this result will not be obtained, as a lack of funds will lead to temporary repairs in some cases when reconstruction would be more economical. With the rapidly increasing number of permanent structures, it is anticipated, however, that within two or three years makshift repairs because of a lack of funds will no longer be necessary.

Ten years ago there were very few bridges of a permanent character in the State, and what is even more significant, no demand for them existed.

The "better bridges" campaign of the State Highway Commission has not only created a universal demand for bridges as nearly permanent as may be constructed, but has in addition directly or indirectly resulted in the actual construction of more than 20,000 such structures.

The volume of bridge work handled by the State Highway Commission is a good measure of the development of modern highway bridge construction in Illinois. Table III shows but slow progress during the first few years of a State Highway Department, but the persistent educational campaign eventually lead to the marked increase which took place during 1915 and 1916 under the revised road law.

It should be held in mind that more than 75 per cent of all drainage structures built each year have spans of less than 9 feet, and but few of these except in connection with State aid road work are handled directly by the State Highway Commission.

The numbers given in Table III do not therefore include a great number of small structures, and not a few large ones built by county superintendents of highways and township highway commissioners, in accordance with the standard practice of the State Highway Commission.

Tables IV and V concerning the bridge work of the State Highway Department for the years 1913, 1914, 1915 and 1916, do not then by any means represent the sum total of modern bridge construction in Illinois for these years.

TABLE III—SUMMARY OF BRIDGE WORK TO JANUARY 1, 1917.

Year.	Plans and specifications prepared.	Estimated cost.	Contracts let on State plans.*	Contract price.	Foreign plans approved.†
1906	15	.....	11	$ 37,035	.....
1907	113	.....	48	41,519	.....
1908	149	.....	64	165,674	.....
1909	122	.....	92	133,285	.....
1910	203	.....	141	148,432	.....
1911	241	.....	127	238,903	.....
1912	214	.....	150	212,694	.....
1913	238	$342,052	139	200,834	5
1914	269	470,363	109	184,792	269
1915	707	984,420	565	541,509	230
1916	735	1,169,743	439	566,657	653
Total	3,006	$2,966,578	1,885	$2,471,334	1,157

NOTE.—The above table does not include bridges and culverts constructed in connection with State aid road work as the cost of such structures is included in the reports on State aid roads. Such information is not available for the years 1913, 1914 and 1915. During the year 1916 plans were prepared for 3,862 bridges and culverts to be constructed in connection with State aid road work, estimated cost $382,840, making a total of 4,597 plans for bridges and culverts prepared during the year, total estimated cost $1,552,583.

* Includes force account bridges placed under construction.

† Plans submitted by county superintendents of highways.

TABLE IV—SUMMARY OF STATE AID BRIDGE WORK, JANUARY 1, 1913, TO JANUARY 1, 1916.

Year.	Plans and specifications prepared by the State Highway Department.						Contracts let on plans prepared by the State Highway Department.								
	Steel.		Concrete.		Total.		Steel.			Concrete.			Total.		
	No.	Total estimated cost.	No.	Total estimated cost.	No.	Total estimated cost.	No.	Total estimated cost.	Total contract price.	No.	Total estimated cost.	Total contract price.	No.	Total estimated cost.	Total contract price.
1913			26	$ 14,265 00	26	$ 14,265 00									
1914															
1915	2	$17,513 00	324	196,852 58	326	214,365 58	2	$17,513 00	$15,334 00	311	$182,963 58	$167,508 65	313	$200,476 58	$182,842 65
1916	2	12,875 00	109	64,678 00	111	77,553 00	2	12,875 00	12,453 00	90	56,986 60	53,456 60	92	69,861 60	65,909 60

NOTE.—The above table does not include bridges and culverts constructed in connection with State aid road work as the cost of such structures is included in the reports on State aid roads. Plans for 3,832 such structures, estimated to cost $382,840.00, were prepared in 1916.

TABLE V—SUMMARY OF TOWNSHIP AND COUNTY BRIDGE WORK, JANUARY 1, 1913, TO JANUARY 1, 1916.

Year.	Plans and specifications prepared by the State Highway Department.						Contracts let on plans prepared by the State Highway Department.									Foreign plans approved.*
	Steel.		Concrete.		Total.		Steel.			Concrete.			Total.			
	No.	Total estimated cost.	No.	Total estimated cost.	No.	Total estimated cost.	No. reported.	Total estimated cost.	Total contract price.	No. reported.	Total estimated cost.	Total contract price.	No. reported.	Total estimated cost.	Total contract price.	
1913	24	$ 78,990.00	214	$263,052.00	238	$ 342,052.00	18	$ 38,400.00	$ 40,295.40	131	$171,302.00	$160,539.05	139	$209,702.00	$200,834.45	5
1914	52	205,048.00	191	251,050.00	243	456,098.00	26	97,833.00	83,322.00	83	106,798.00	101,470.15	109	206,626.00	184,792.15	269
1915	62	248,090.00	319	521,965.00	381	770,055.00	37	129,380.00	115,353.09	215	275,235.00	243,313.19	252	404,615.00	358,666.28	230
1916	79	492,700.00	545	599,490.00	624	1,092,190.00	35	148,748.00	148,608.44	312	383,018.00	352,139.23	347	531,766.00	500,747.67	653

* Plans submitted by county superintendents of highways.

No data is at present available, which would show definitely the actual progress now being made. Arrangements are perfected, however, by means of which this information will soon be available.

It is recognized that the actual annual highway bridge expenditure at the end of a ten year period may vary from any estimate which may be made by a wide margin.

In the light of our present knowledge, however, we believe it to be conservative to estimate that our annual bridge expenditure will be reduced to one-half of the present figure in ten years more, if the present system of control of highway bridge construction be maintained or improved.

CARING FOR STEEL BRIDGES.

As we now have some thirty thousand steel bridges, and such structures will no doubt always exist on our public highways, it is a matter of considerable importance that they be cared for in such a manner as to prolong their life as much as possible.

Fig. 1. Corroded condition of vertical post, probably largely due to the use of salt for clearing the sidewalk from ice and snow.

By far, the greatest number of renewals is made necessary because of insecure foundations. In many cases, the construction of well built concrete foundations will prolong the useful life of an old steel superstructure for many years.

The foundations of old steel bridges, particularly those of tubular, post or leg construction, should then be examined with the object of determining the possible ultimate economy of new and substantial abutments or piers.

Corrosion or rusting is also of sufficient importance to merit the adoption of protective measures.

It is a regretable fact that our steel highway bridges are rarely painted.

It is a matter of common knowledge that steel structures located in cities or near railroads, rust rapidly if not properly protected from the gases produced by the burning of bituminous coal. This is particularly noticeable where steel bridges are used to span the tracks of a railroad.

The fact that such structures cannot be neglected without danger of serious results is well illustrated by a case recently investigated. The structure was a pony truss bridge carrying a highway over the tracks of an important railroad. In this structure wood beams were used to support the floor planks. These wood beams were placed at right angles to the roadway and rested on the outstanding legs of the lower chord angles of the trusses. The lower chord was composed of two 4 inch by

Fig. 2. Corroded condition of end post after about 15 years of service, partly due to the use of salt for clearing the sidewalk from ice and snow. The buckled condition of the cover plate is due to the expansive action of rust scale.

6 inch by ½ inch angles. The floor planks were placed diagonally with respect to the roadway. The outstanding legs of the lower chord angles for a distance of about 3 feet over the track were entirely destroyed by corrosion and the vertical legs were materially effected.

It is quite likely that the dangerous weakness of this bridge would not have been discovered had it not been for the fact that the arrangement of the floor supports was such that two of the transverse wood beams were left unsupported and finally fell to the track below. This bridge had been completed but five years.

Salt used for the purpose of clearing the side walks and roadway of the bridge from ice and snow is at lease partly responsible for the corroded condition of the vertical post, shown in Figure 1 and the end post shown in Figure 2. This bridge had been in service about fifteen years.

In southern Illinois a peculiar condition exists which undoubtedly has a material bearing on the corrosion of steel structures. In that part of the State popularly known as Egypt, a large proportion of the soil when tested, shows a marked acid reaction. This condition exists generally throughout the greater part of the State which lies south and east of the Kaskaskia River and south of the latitude of Mattoon. To a less marked extent, the soil is acid in many places elsewhere in the State where the land has been farmed for a considerable period.

Steel buried more than a few inches below the surface does not seem to exhibit any unusual tendency to corrode. The greatest effect is noticeable at, or slightly above the ground surface and at other places where dirt may become lodged. Such accumulations of dirt are constantly being washed away by the rains and are again replaced by a fresh supply of acid soil brought by the wheels of vehicles, the wind or other agencies.

Fig. 3. Corrosion of channels, after ten years of service, due to the acid condition of the soil.

Wherever this acid soil accumulates readily as it does about the shoes, stringers, floor beams, lower chords, and elsewhere below the floor of the bridge, corrosion is very rapid unless the steel is kept well protected by paint or is incased in concrete.

An examination of many steel structures in the district outlined has disclosed the fact that steel plates, angles, or the webs of channels or I beams having a thickness of one quarter of an inch or less, when exposed on both sides to the conditions mentioned, are completely destroyed by corrosion in from ten to twelve years.

Examination of comparatively new structures seems to indicate that the initial coat of paint which is usually of poor quality, affords protection for two or three years. The period of active corrosion is therefore probably not longer than eight or ten years.

Figure 3 is from a photograph of channels removed from a small bridge which was located near Hillsboro, Montgomery County, Illinois. This bridge had been in service only ten years. The original thickness of the web was two-tenths of an inch. The position of the most rusted portion, was about twelve inches below the floor of the bridge where a shelf angle formed a lodging place for dirt which sifted through the cracks of the plank floor. The soil is markedly acid in this neighborhood.

Another peculiar effect of rust action has been observed a number of times during recent years.

In examining steel bridges which have been erected for some time, it has frequently been noted that the edges of thin plates, such as the cover plates of compression members, when riveted to the flanges of channels or I-beams, frequently show a wavy or scalloped appearance. Where this occurs, the plate near the rivets is in contact with the flange of the channel, but between rivets the plate is bulged out in some cases as much as three-eighths of an inch, the space between the plate and flange being filled with dirt and rust scale. This condition is distinctly noticeable in case of the end post shown in Figure 2.

It was not immediately recognized that this buckled condition of thin cover plates was due to the expansive action of rust scale as it was formed between the plate and the flange of the channel or I-beam. That this is true however, is evidenced by the fact that comparatively new structures do not show any appreciable buckling of thin plates between rivets and it is inconceivable that faulty shop work should be responsible for the frequent appearance of this phenomenon in bridges built by many different shops and at different periods of time.

The volume of solid iron rust is approximately twice the volume of the metal from which it is formed and as rust scale is always more or less porous, thus still further increasing its bulk, the corrosion of a comparatively thin surface layer of each piece produces a sufficient bulk of rust scale to force the pieces apart, thereby causing the bending of the cover plate between rivets.

The buckling of one of the component pieces of a compression member, of course, seriously reduces the capacity of that piece to take compressive stresses.

A remarkable instance of the expansive force exerted by rust scale was noted on a bridge which spans Fox River at Ottawa, LaSalle County, Illinois.

This structure has a single span of two hundred thirty-four feet. The bridge has an 18 foot clear roadway and a 7 foot side walk outside of one truss. The trusses are really trussed parabolic arches having a center height of 26½ feet. It was completed in 1869. (The arch members are made up of Phoenix sections, plates and channels.)

The various structural sections of the arch are connected by means of half inch rivets spaced six inches apart.

Because of the thickness of the metal, width of flange and shape of the section, the flanges are very stiff.

A scale of rust about three-sixteenths of an inch thick formed on each side of the web plate, between the plate and the flanges of the

adjacent sections. The expansive force exerted by the formation of this scale ruptured practically all of the rivets connecting the upper and lower halves of the ribs, from one end of the bridge to the other. Figure 4 is from a photograph taken of one of the arch ribs near the end of the bridge. A length of ten feet partly shown in this picture had but one unbroken rivet. The blade of the knife is inserted where the shank of the rivet ought to be.

In some cases the heads of the rivets were pulled off but usually the break occurred in the shank. In a few cases the head was pulled off and the shank broken as well. Examination of the ruptured rivet ends indicated, by varying degrees of corrosion, that some of the rivets had

Fig. 4. Ruptured rib of 234 foot steel arch span, caused by the expansive action of rust scale. The blade of the knife is inserted through the break in the shank of a rivet. More than 90 per cent of the rivets in this joint were found broken.

probably been broken several years, while others exhibiting almost no rust, had undoubtedly been ruptured quite recently.

It was found that not more than 10 per cent of the rivets connecting the upper and lower halves of the arch ribs were unbroken. It is probable that friction and crooked shanks, due to mismatched holes had held the parts together. There was strong evidence of a recent working of these joints.

It is evident, that the provision of the department's specifications which requires the thorough painting of contact surfaces before the same are riveted together, is of the utmost importance.

The above discussion is given to emphasize the fact that rust is a real and serious enemy of steel bridges.

Several years ago, the State Highway Commission, as a result of a study of possible means of protecting steel bridges from corrosion,

adopted the paint specifications now in use. The selection of sublimed blue lead and pure linseed oil was based on the results of tests carried out under the direction of the American Society for Testing Materials. At the conclusion of these tests, this paint with one exception, was rated higher than any other single pigment paint. The exception was American Vermilion in linseed oil, which at present is prohibitive in cost. The paint selected has been used for several years with excellent results.

Sublimed blue lead has a slate color which is easily imitated and substitutions are not uncommon. Imitations are very likely to afford poor protection and are not easily detected except by chemical analysis.

STANDARD BRIDGE PLANS.

It is not considered the best engineering practice to adhere rigidly to any set of standard plans for bridges. When a limited number of standards are available, a designer in order to minimize office work, is apt to use a standard plan although it may not be adapted perfectly to the conditions at the site for which it is intended. In highway work, however, the legitimate use of standard plans may cover a much broader field than would be the case in many other fields of engineering work, as for instance in railroad construction.

This is due chiefly to the fact, that because of the light grading which prevails in highway work, but few drainage structures are covered by fills deeper than the minimum necessary to provide for a wearing surface.

Under such conditions it may be seen, for example, that because of uniform load conditions, a set of standard superstructure plans suitable for ordinary highway loads and adapted to common widths of roadway and practically all lengths of span, may easily be prepared. The number of such standards required to cover the common range of variables is not prohibitive.

A series of standards sufficiently elaborate to provide satisfactorily for fully 75 per cent of the culverts may also be prepared without great difficulty. Of course culverts under fills, as well as those requiring other special treatment may involve so many variables that standard plans, complete in themselves, are impracticable.

Abutment plans involve so many variables, such as height, length of wings, width of roadway and dimensions dependent upon the span length of the superstructure, that any set of standards, from which might be selected complete plans to fit even all ordinary conditions, would require a prohibitive number of drawings.

Such an enormous number of highway drainage structures must be built in the State each year (approximately 15,000) and the calls upon the State Highway Department for plans are so numerous, that the preparation of an elaborate series of standard plans has been imperative.

GENERAL DESCRIPTION OF STANDARD BRIDGE DRAWINGS.

In the preparation of the standard bridge plans now in use by the department, special tracings were made for each standard, on sheets

measuring between trimming lines, 22 by 28 inches, and measuring 21 by 27 inches between margin lines. Each tracing was given a distinguishing number. Special care was used to insure that when reduced one-half, all figures and letters would be legible and all lines distinct. Ample room was also allowed for lettering, on the reduced plans, dimensions, notes and other information. From these tracings zinc etchings, having a scale exactly one-half that of the original tracings, were made.

From these etchings were made on an ordinary printing press a supply of prints on thin paper of good quality. The number of prints from each standard being the estimated number required for one years work. The sheets on which the etching prints are made measure 11 by 15½ inches, and provide an ample binding margin at the left eleven inch side. The specifications are in book form and measure 11 by 8½ inches. The etching prints or blue prints made from them when folded once conform as to size with the specifications to which they are clamped.

Certain of the etching prints show, in complete detail, all information necessary for the building of the work for which they are intended, and when such is the case, the proper etching prints are attached to the specifications and are referred to in the proposal sheets by standard number. Others are more or less incomplete and therefore require additions before they may be used. In such cases the necessary information is added by hand and blue prints made for use with the specifications.

CULVERT STANDARDS.

As over 76 per cent of all drainage structures have spans of less than 9 feet, considerable care has been given to the development of standard culvert plans. The series of culvert standards is so designed, that in general unless the culvert is located under a fill or requires other special treatment, an assembler may from an index sheet select a standard which will provide exactly the type, shape and area of waterway, length of barrel, design of end walls and other features required to fit the site. The standard so selected shows complete dimensions and bill of material.

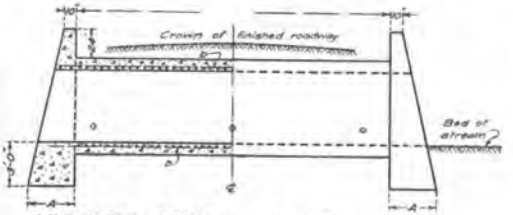
A series of sixteen etching prints providing waterway areas from one to about fifty square feet serves this purpose. This series covers pipe culverts with end walls suitable for farm entrances; pipe culverts with end walls suited to cross road culverts; semi-circular arch culverts with end walls suited to farm entrances; same with end walls suited to cross road culverts; box culverts for farm entrances; cross road box culverts with reinforced concrete top slab, paving, side walls and end walls; and cross road culverts having plain concrete side and end walls with the top slab and paving only reinforced.

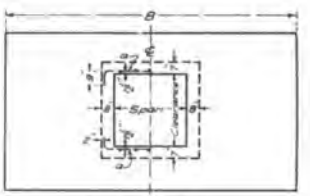
In addition, three etchings are provided with all demensions, size and spacing of reinforcing material, etc., left blank. These are arranged for culverts to be built under fills. They serve only to save the time necessary to make drawings. Such plans can not of course be scaled in the field.

A description of the method used to develop the wide range of conditions covered by one of the four etching prints representing box culverts with plain concrete end walls and side walls with top slab and

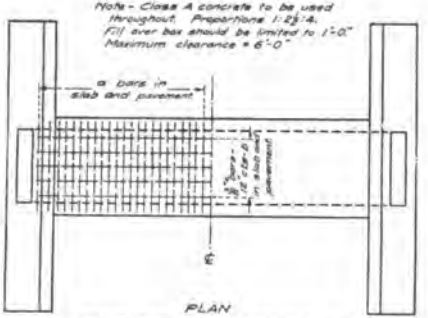
STATE OF ILLINOIS
STATE HIGHWAY DEPARTMENT

CONCRETE BOX CULVERT.





Note - Class A concrete to be used throughout. Proportions 1:2½:4.
Fill over box should be limited to 1'-0" Maximum clearance = 6'-0"



SHOWING REINFORCEMENT. SHOWING OUTLINES.

BILL OF MATERIAL

Design	Span	Clearance	Width of Footing A	Length of Headwalls B	Reinforcing Steel					Steel Lbs	Concrete Cu. Yds.
					Bars	No.	Size	C to	Length		
1	5'-0"	1'-6"	2'-0"	11'-0"	a		⅝"	5½			
					b		⅝"	12"			
2	5'-0"	2'-0"	2'-3"	12'-6"	a		⅝"	5½			
					b		⅝"	12"			
3	5'-0"	2'-6"	2'-3"	14'-0"	a		⅝"	5½			
					b		⅝"	12"			
4	5'-0"	3'-0"	2'-6"	15'-6"	a		⅝"	5½			
					b		⅝"	12"			
5	5'-0"	3'-6"	2'-9"	17'-0"	a		⅝"	5½			
					b		⅝"	12"			
6	5'-0"	4'-0"	2'-9"	18'-6"	a		⅝"	5½			
					b		⅝"	12"			
7	5'-0"	4'-6"	3'-0"	20'-0"	a		⅝"	5½			
					b		⅝"	12"			
8	5'-0"	5'-0"	3'-3"	21'-6"	a		⅝"	5½			
					b		⅝"	12"			
9	6'-0"	1'-6"	2'-0"	12'-0"	a		⅝"	6"			
					b		⅝"	12"			
10	6'-0"	2'-0"	2'-3"	13'-6"	a		⅝"	6"			
					b		⅝"	12"			
11	6'-0"	2'-6"	2'-3"	15'-0"	a		⅝"	6"			
					b		⅝"	12"			
12	6'-0"	3'-0"	2'-6"	16'-6"	a		⅝"	6"			
					b		⅝"	12"			
13	6'-0"	3'-6"	2'-9"	18'-0"	a		⅝"	6"			
					b		⅝"	12"			
14	6'-0"	4'-0"	2'-9"	19'-6"	a		⅝"	6"			
					b		⅝"	12"			
15	6'-0"	4'-6"	3'-0"	21'-0"	a		⅝"	6"			
					b		⅝"	12"			
16	6'-0"	5'-0"	3'-3"	22'-6"	a		⅝"	6"			
					b		⅝"	12"			
17	6'-0"	5'-6"	3'-3"	24'-0"	a		⅝"	6"			
					b		⅝"	12"			
18	6'-0"	6'-0"	3'-6"	25'-6"	a		⅝"	6"			
					b		⅝"	12"			

749

Fig 5.

paving reinforced, will serve to illustrate the means whereby the 16 culvert etchings are made to cover practically all necessary variations in area and shape of waterway and length of barrel (length of barrel is governed by the shoulder to shoulder width of graded way).

The four etchings mentioned are called standards 748, 749, 750 and 751 and show these numbers near the lower right hand corner. A reproduction of standard 749 is shown as Figure 5 and its development will be described.

It will be noted that the following variables are shown on the drawing proper; width of roadway, thickness of end wall footing bases, cross section, number, spacing and length of reinforcing steel, length of end walls, span and clearance. It will also be noted that with the exception of width of roadway, the variables are either lettered or named. The bill of material shows eighteen different designs which cover span lengths of 5 and 6 feet and clearances for each span length varying by 6 inch intervals from a minimum of 18 inches to a maximum equal to the span length. As the length and base thickness of the end walls and cross section and spacing of main reinforcing bars are dependent only upon the span and clearance, these items are scheduled in the bill of material for each design. The number and length of reinforcing bars, total weight of steel and total volume of concrete are dependent upon the width of roadway. To complete the range for which this standard is available, on an etching print is lettered a standard width of roadway, the corresponding bill of material is completed for each of the eighteen designs and the etching print is given a "sub-standard number" such as 749—1. The etching print is thereafter known as sub-standard seven forty-nine dash one, and blue prints therefrom show all information necessary to construct culverts of the type and width of roadway provided by this sub-standard and with eighteen different combinations of span and clearance. Other prints are filled in for all of the various standard roadways.

With some variation, this general scheme is applied to prints from the other fifteen culvert etchings. From the etching prints, complete drawings are thus made which provide for a very wide range of conditions. The completed system of sub-standards allows for a selection from more than a thousand complete culvert plans each differing from the other either in type of construction, shape or area of waterway, length of barrel, or design of end walls. The selection may quickly be made by reference to classified index sheets which give the standard and sub-standard number, and also the total quantities of steel and concrete.

In making up road plans conventional signs and station numbers are used to show the location of culverts. They are described by indicating the standard, sub-standard and design numbers, which together with the quantities needed for estimating purposes are taken from the index sheets. The actual sub-standards are thus not needed until the work is advertised. Blue prints are then attached to the road plans together with a schedule of the culvert designs to be used.

Although such a complete series of culvert standards is available, about ten per cent of all culvert plans require special preparation. A

rule of practice in the Bureau of Bridges, prescribes that proper design be not sacrificed in order that standard plans may be used.

STANDARDS FOR REINFORCED CONCRETE SLAB SUPERSTRUCTURES.

The standard plans covering reinforced concrete slab-superstructures provide for clear spans of from 10 to 30 feet, inclusive, varying by 2 foot intervals, clear roadways of 16, 18, 20, 24 and 30 feet, and guard rails of 3 different types. The etching prints are of the same size and were prepared in the same manner as described for the culvert standards.

The drawings proper of each etching print provide for a single span length and show complete details and dimensions with the exception of items dependent upon width of roadway. Three different types of rail, distinguished by the letters A, B and C, are also shown on each etching. On each print is shown three bills of material, corresponding to each of the three rail designs, for widths of roadway of 16, 18, 20, 24 and 30 feet. The fifteen bills of material thus shown on each standard complete the information necessary to construct a superstructure having any of the widths of roadway mentioned and any of the three types of guard rail provided.

The etching prints may then be used without blue printing, providing the prints are marked with the width of roadway and type of rail desired, or providing these items are otherwise specified. Usually, however, a single print is marked with the width of roadway and type of rail desired, and a title stamped in a small printing press. Copies are then made by the blue print process.

The three types of guard rail are provided to allow for variations in ornamental effect. Two of the rail designs are for concrete and one for posts, base and coping of concrete and a web of brick work divided into panels by open spaces. The brick webbed rail may of course be varied to produce a wide range of color and surface texture effects. Such a rail costs but little, if any more than a paneled concrete rail, while it adds much to the appearance of the structure.

The eleven etching prints for slab superstructures (spans 10 feet to 30 feet inclusive) provide for 165 designs, complete in all details, each differing from the other either in length of span, width of roadway or type of guard rail.

In order properly to meet all conditions, about 25 per cent of all slab bridge plans reuire special drawings or additions or alterations to the standard plans.

STANDARD PLANS FOR REINFORCED CONCRETE THROUGH GIRDER SUPERSTRUCTURES.

This series of standard plans for which 24 etchings have been provided covers clear spans, 30 to 65 feet in length varying by 5 foot intervals and roadways of 16, 18 and 20 feet.

Wider roadways are not often called for, and when demanded, the conditions frequently are such as to render deck girder or arch designs more economical or otherwise more desirable. Standard plans for girder structures providing roadways wider than 20 feet have not therefore been prepared.

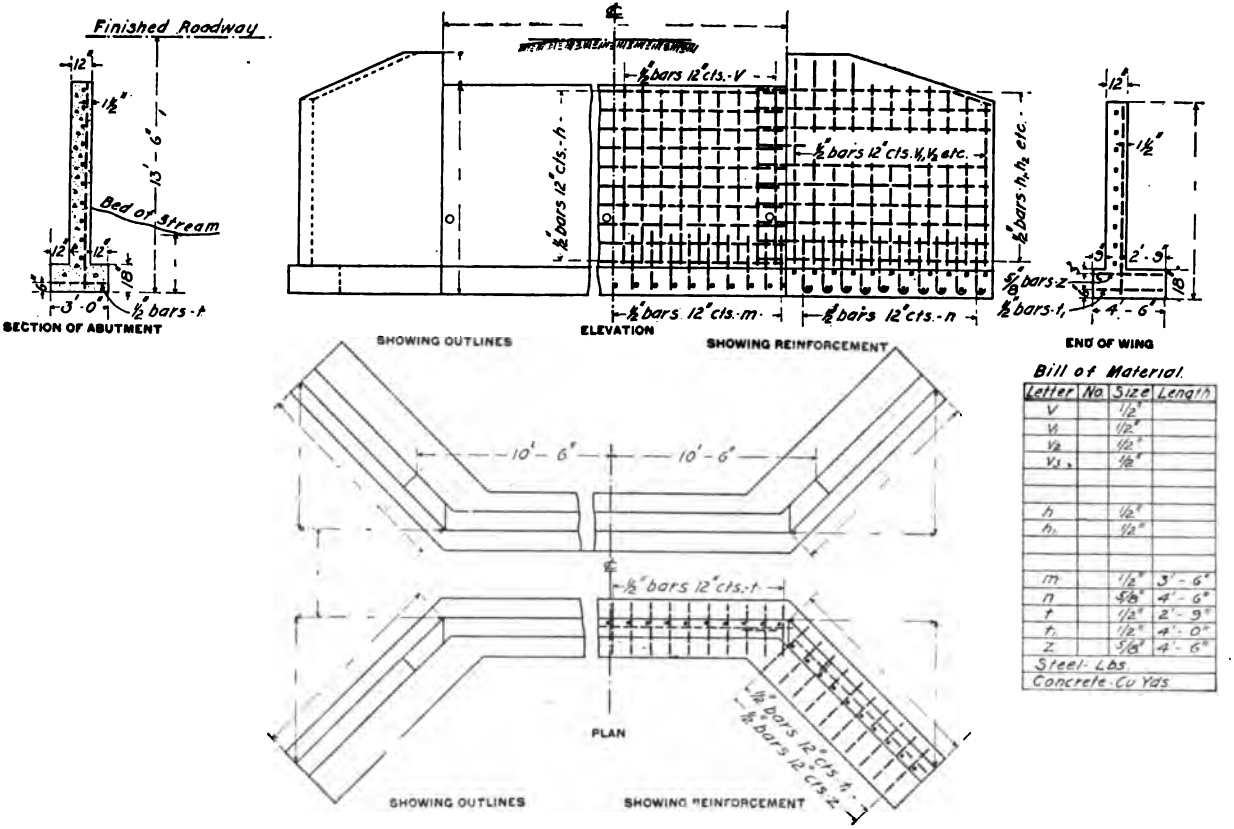


Fig. 6. **Typical standard plan of reinforced concrete abutments for slab bridges. Cantilever type wings**

Each girder superstructure standard provides for but one span length and one width of roadway. This permits showing all information, including a bill of material, necessary for the construction of the superstructure. Either the etching prints or blueprints from the same may be used without alterations or additions, other than a title when such a designation is necessary.

Owing to the necessity of providing for skew bridges, multiple spans, wide roadways, etc., special or auxiliary plans are found necessary for about 25 per cent of all girder bridges.

STANDARD PLANS FOR PLAIN AND REINFORCED CONCRETE ABUTMENTS FOR SLAB AND GIRDER BRIDGES.

In the design of abutments so many variables are involved, that the adaptation of standard plans presents many difficulties.

The preparation of plans for plain concrete abutments is so simple that only two etchings have been provided, one for slab and the other for girder superstructures. These standards show outlines, blank dimension lines (except for a few fixed dimensions) and a space in which to show the quantity of concrete required.

In using these standards, a draftsman computes all dimensions and quantities required and adds this information to an etching print which is then blue printed for use. The etching prints save merely the time necessary to make drawings. As such drawings may not be scaled, sufficient dimension lines are provided to completely define all parts of the abutment.

The preparation of standard plans for reinforced concrete abutments for slab and girder bridges presented considerable difficulty on account of the large number of variables involved. The saving in office work, however, justified the preparation of about 50 etchings.

This series includes four groups of standards. Group 1 includes standards for reinforced abutments for slab bridges with wings designed on the cantilever principle. Group 2—abutments for slab bridges similar to the U type with wings restrained near the top by ties across the roadway. Groups 3 and 4 correspond with 1 and 2 in type, but are arranged for through girder superstructures.

Figures 6, 7 and 8 illustrate typical standards of groups 1, 2 and 3 respectively. These figures were published in the fourth report of the old State Highway Department, and in detail differ slightly from the present standards, but are substantially the same as those at present in use.

Each group consists of a series of standards providing for over all heights varying by intervals of 1 foot from about 9 to 20 feet.

For heights less than 9 feet, plain concrete abutments are practically always cheaper than reinforced concrete. Calls for heights greater than about 20 feet are not frequent, particularly for slab bridges.

The standard abutment plans of this series show all information which is independent of length and angle of wings, and design of the superstructure.

To use these standards, an etching print is selected which provides for the desired type and overall height, and on this sheet is lettered the

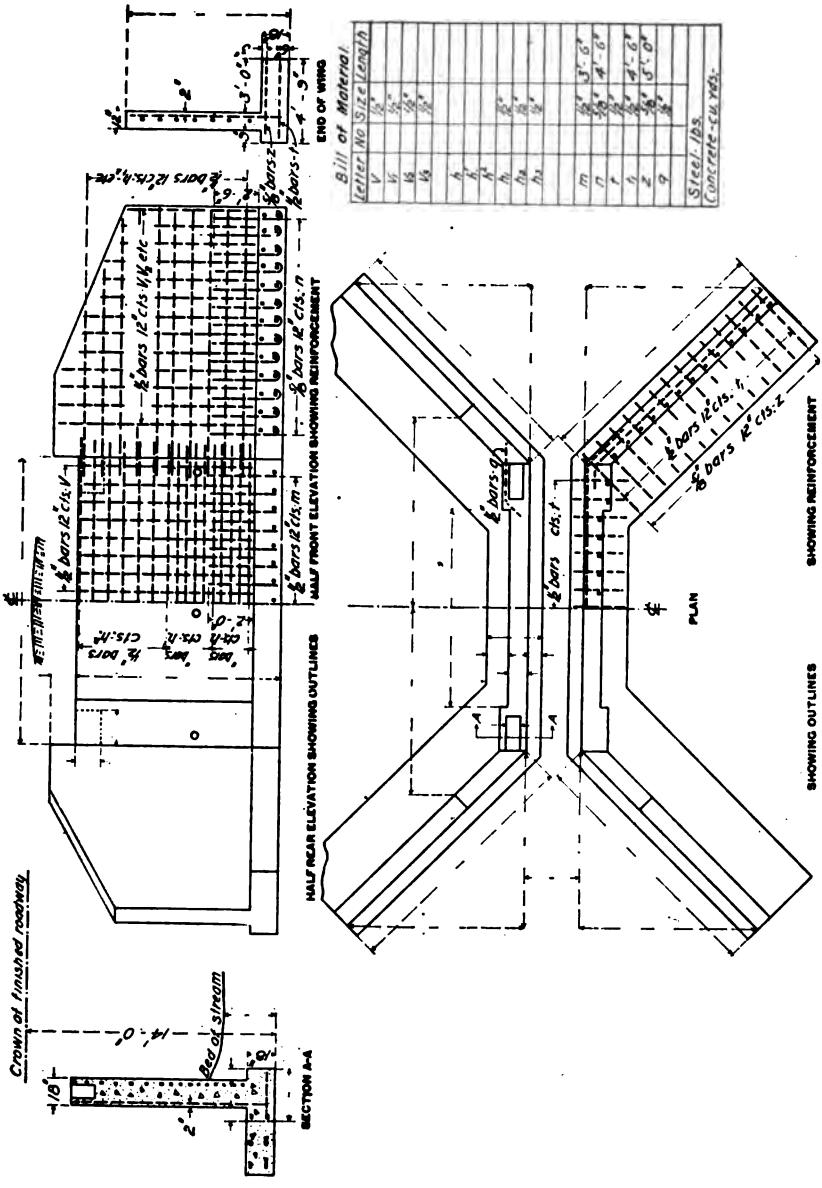


Fig. 7. Typical standard plan of reinforced concrete abutments for girder bridges. Cantilever type wings.

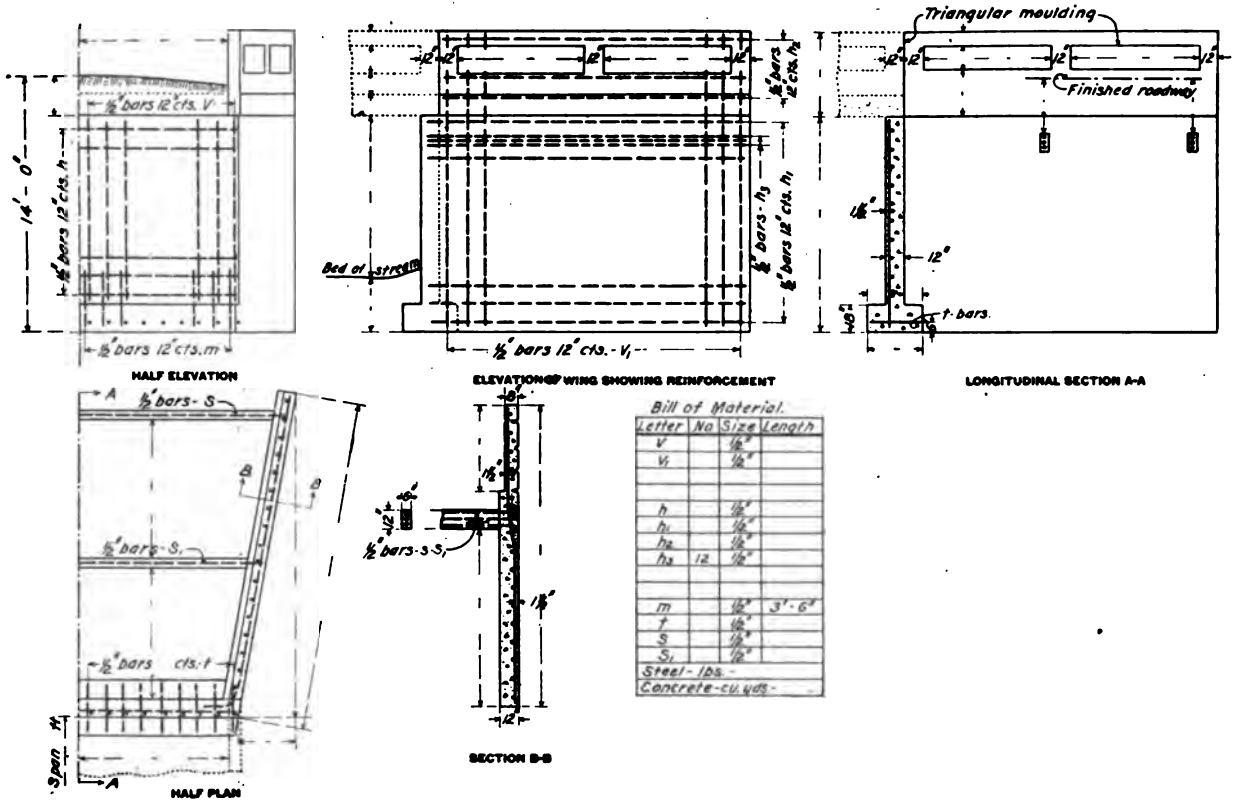

HALF ELEVATION
ELEVATION OF WING SHOWING REINFORCEMENT
LONGITUDINAL SECTION A-A
HALF PLAN
SECTION B-B
Triangular moulding
Finished roadway
Bed of stream
Span
Bill of Material.
Letter | No | Size | Length
V | | ½" |
V1 | | ½" |
h | | ½" |
h1 | | ½" |
h2 | | ½" |
h3 | 12 | ½" |
m | | ½" | 3'-6"
f | | ½" |
S | | ½" |
S1 | | ½" |
Steel - lbs. -
Concrete - cu. yds. -

Fig. 8. Typical standard plan of reinforced concrete abutments for slab bridges. Wings restrained at top by ties across the roadway.

information necessary to adapt the standard to the particular superstructure standard selected, and that necessary to define the length, angle and slope of the wings. The bill of material is then completed.

No structural designing is necessary to complete one of these standards, as with but one exception, the size and spacing of reinforcing steel and thickness of concrete are shown on the etching prints. The exception is that of the horizontal reinforcing bars (h, h^1, h^2, etc.) in the main wall of reinforced concrete abutments for girder bridges. (See Figure 7.) This information is taken from tables which cover all heights and all widths of roadway.

No attempt has been made to develop for abutments a system of sub-standards, each suitable and complete for a given set of conditions such as those previously described for culverts. The reason for this may be appreciated when it is considered that even if a standard wing length and angle could generally be used for a given height, a slab or girder bridge abutment of a certain type and overall height, would vary with each different span length and roadway width of superstructure. There are in use eleven slab superstructure standards, each providing for five different roadways. This, even if standard wings could be used, would make necessary fifty-five sub-standards for each slab abutment standard, and half as many for the girder abutment standards.

In lieu of sub-standards, a record card for each abutment standard is kept, on which is entered a record of each superstructure with which it is used, and the identifying number of the bridge. By reference to these cards, it is possible quickly to determine whether or not a given standard has previously been used for the same conditions. If so, by means of the bridge number, the plans are readily located in the files and copies made on new etching prints.

Twenty-five per cent or more of all abutment plans require special or supplementary drawings.

OTHER STANDARD PLANS.

For all of the previously described standard plans, zinc etchings and a supply of prints therefrom have been obtained, or have been ordered.

A large number of other standard plans are in use for which no etchings, at least in the near future, will be obtained. This number includes standard plans which are not used frequently enough to justify the expense of procuring zinc etchings. Among these are standard plans for steel superstructures, plain and reinforced concrete abutments for steel bridges, abutments of unusual height for slab and girder bridges, and others.

These standard plans are maintained as tracings measuring 22 by 28 inches between trimming lines. Prints folded on the 1/3 lines each way then correspond in size with the specifications.

On these tracings variable dimensions, quantities, etc., are left blank. To adopt these standards to a particular bridge, a sheet of tracing cloth is laid over the standard and match marked. The blank dimensions, quantities, etc., together with the standard number with which it

is used are then lettered on the "cover sheet," as it is called. A title and the designating number of the bridge are printed also on the "cover sheet" which is pinned to the tracing of the standard when blue prints are made. The blue prints then appear as complete drawings. The standard tracings and "cover sheets" are filed separately but may easily be assembled, at any time when prints are desired. This system is but little less convenient than where etching prints are used.

ADVANTAGES AND DISADVANTAGES OF THE SYSTEM OF STANDARD PLANS.

In general, the advantages of standard plans are as follows:

A great amount of time otherwise needed to make computations and drawings, many times duplicated, is saved; uniformity and consistency of design are secured; errors of oversight are largely eliminated, the possibility of errors in computation are much reduced because many features of each standard design are fixed; and because of the uniform arrangement of the drawings and methods of dimensioning, construction and inspection are facilitated. The principle disadvantages are the tendency to use standard plans when special designs may be needed to fit conditions at the bridge site, the impracticability of arranging standard drawings so as to permit general scaling, and the inertia necessary to be overcome in order that the standard plans may be kept abreast of modern practice.

The use of prints from zinc etchings as compared with the "tracing cover sheet" system presents the advantage of having complete information on each sheet of the drawings, rather than on cover sheets which must be matched with the proper tracings when duplicates are desired. In addition, prints of the same standard may be used by several draftsmen at the same time which is not possible with the standards made on tracing cloth. The etching prints, when complete in themselves, as for instance, those for the through girder superstructure standards, may be used without blue-printing. These items, although seemingly small, are of great importance when a large volume of work must be handled.

During the year of 1916 the office force of the bridge bureau prepared plans and specifications for a total of 4,597 highway drainage structures, checked by mathematical computation and comparison with tables 653 bridge plans prepared by other engineers, and checked the detailed shop drawings and made shop inspection of all steel bridge work under construction. In addition, a considerable number of standard plans were prepared.

During the one month of April, 1916, plans and specifications were prepared for 1,447 drainage structures. At that time sixteen draftsmen were employed. It may readily be understood that without an elaborate system of standard plans this result would have been impossible.

If we include the entire office pay roll of the bureau of bridges, including stenographers and blue print clerks, plus 15 per cent for general office overhead and make no deduction for the time used in checking the 653 plans submitted for approval, or for the checking of shop drawings and making shop inspection of steel work, the cost of preparing bridge plans and specifications amounts to 1.47 per cent of the

estimated cost of the structures for which plans were prepared. This figure is no doubt somewhat in excess of the actual cost.

No estimates of cost are available for work covered by the 653 plans checked, and no separate record was kept of the cost of checking these plans or of the cost of checking shop drawings and making shop inspection of steel work. It is conservative to estimate that the time spent in checking the 653 plans was at least equal to that which would have been necessary for the preparation of an equal number of average bridge plans as in the main they were plans for arches and types of construction differing from those in common use by the department. If this is true and a corresponding amount is deducted, then the actual cost of preparing the plans and specifications would be 1.29 per cent of the estimated cost of the work for which plans were so prepared. This is believed to be a very fair figure. If we charge to the preparation of bridge plans and specifications, only the cost of the office engineering force engaged on this work, eliminating the cost of stenographic and blue print service and general office over-head expense, and deduct the estimated cost of checking plans prepared elsewhere this figure is reduced to 0.97 per cent.

By the use of the system of standards described, it has been possible to hold the cost of preparing plans for a large number of small units of work, estimated to cost in the aggregate more than one and one-half million dollars, to a figure which compares favorably with the cost of preparing plans for large units of construction.

PART III

Bureau of Maintenance

REPORT OF BUREAU OF MAINTENANCE.

(B. H. PIEPMEIER, Maintenance Engineer.)

The work of this bureau consists of three distinct divisions, namely:

1. Maintaining all State aid roads.
2. Assisting township officials in road construction.
3. Distributing crushed stone from the State penitentiaries for township road construction.

The principal work of the Bureau of Maintenance is that of directing the maintenance of all State aid roads. However, during the last three years, a great deal of attention has been given to the other two divisions of work with which this bureau is charged.

Prior to the enactment of the State Aid Road Law, July 1, 1913, the principal work of the State Highway Commission was that of advising township and county road officials concerning the proper construction of roads and bridges.

This assistance furnished by the State Highway Commission prior to the enactment of the present road law proved so popular in various districts throughout the State, and the advantages and benefits derived were so evident, that the continuation of such work, after the passage of the State Aid Law in 1913, seemed not only advisable, but necessary. As a consequence, this work has been continued by the State Highway Department under the supervision of the Bureau of Maintenance.

MAINTENANCE OF STATE AID ROADS.

Administration.—During the past year the Bureau of Maintenance has been organized and developed under the general direction of the Chief State Highway Engineer and personal direction of the maintenance engineer. Prior to 1915 very little maintenance work was required on State aid roads, and the small amount of work which was undertaken was performed without any definite system or plan.

In accordance with the method in use throughout the various bureaus of the State Highway Department all maintenance work during 1915 and 1916 has been handled by the division engineers under the general direction of this bureau.

General orders were issued covering all ordinary maintenance work. Each special or unusual job, the estimated cost of which exceeded $25 was authorized by the bureau before being undertaken. After proper authorization the division engineers then proceeded to execute

the work in their respective divisions through the resident engineers, the county superintendents of highways or private individuals. A special effort has been made in all cases to secure the most economical method of performing the work, and to accomplish that end, the division engineers in each specific case, have chosen from the available men the one

Fig. 1. Ford maintenance truck, with heating kettle and incidental tools. Used for maintaining State aid concrete and brick pavements.

who seemed most conveniently located and capable of doing the work in the most efficient manner.

Practically all materials used in maintenance work have been purchased through this bureau. These materials and also such equipment as has been required have been furnished to the division engineers upon

request. Special efforts have been made to locate sources of materials and to ascertain the prices of such materials so that all orders might be placed quickly and to the best advantage.

In a few cases a specific piece of maintenance or upkeep work has been let by contract when it was evident that such a system would result in greater economy than the day labor method.

Maintenance and Upkeep.—The maintenance work as a whole has been subdivided into two parts, (1) the maintenance of the wearing surface proper and (2) the upkeep of side roads, ditches and drainage structures. In the discussions following, *maintenance* will then be considered to mean only work done on the traveled portion of the highway or wearing surface, while *upkeep* will be understood to mean all work of a general nature such as grading side roads, cleaning ditches, cutting weeds and repairing drainage structures. It is self evident that the cost of upkeep will be practically constant per mile of road regardless of what type of road surface may be used. On the other hand maintenance will vary with the type of wearing surface used. It is therefore necessary in keeping costs of this work to separate upkeep from maintenance in order that the suitability of the type may be studied. It is expected that the cost data on the maintenance of the wearing surface will be of great value in comparing the relative efficiency of different types of roads when conditions are similar.

Up to the present time the maintenance work has consisted mainly of filling cracks and joints in concrete pavements with bituminous material. A very slight amount of work has been done on the brick surfaces.

Upkeep work to date has consisted largely of dragging and building up earth and metal shoulders, cleaning ditches, cutting weeds and cleaning culverts.

Field Methods Used.—In order to facilitate the work of filling cracks and joints in Division No. 1, where the greatest amount of such work was done a special Ford truck was devised. During 1915 this truck traveled about 7,500 miles over the northern and central portion of the State. Attached to the rear of the truck was a fifty gallon tank utilized for heating the bituminous material used in filling the cracks and joints in concrete pavements. Heat was applied to this tank by means of six gasoline burners. The truck was also equipped with tools for cleaning cracks and joints, and with a box for carrying the sand used in covering the cracks after they were filled. One man was placed in charge of the truck during the entire season, and he was given authority to employ such labor and to purchase such incidental material as was required to do the work. During 1915 the Ford truck proved to be very economical. While there were a number of days when weather prevented work, few delays were encountered in reaching the job or in traveling from one place to the other. One of the main advantages of this truck was that it enabled one man to devote his entire time to maintenance work, and while in many instances the cost was not reduced, a much superior quality of work resulted.

In the other divisions small portable heating kettles were supplied. These had a capacity of approximately seventy-five gallons and were

arranged so that the bituminous material could be heated by either coal or wood. The kettles were shipped from place to place and hauled to the job by a team. No one was definitely assigned to this work, but an engineer from one of the division headquarters was placed in charge of such work whenever the roads required attention.

A comparison of the cost of the maintenance of pavements by means of the Ford and the portable kettles shows that the Ford effected a saving of one-third in the cost of the season's work.

The tools carried by a maintenance gang consisted of one wire brush broom, one mixed fibre broom, one house broom, one pouring can, one shovel and one heavy scratching tool for removing foreign matter and disintegrated material from joints and cracks.

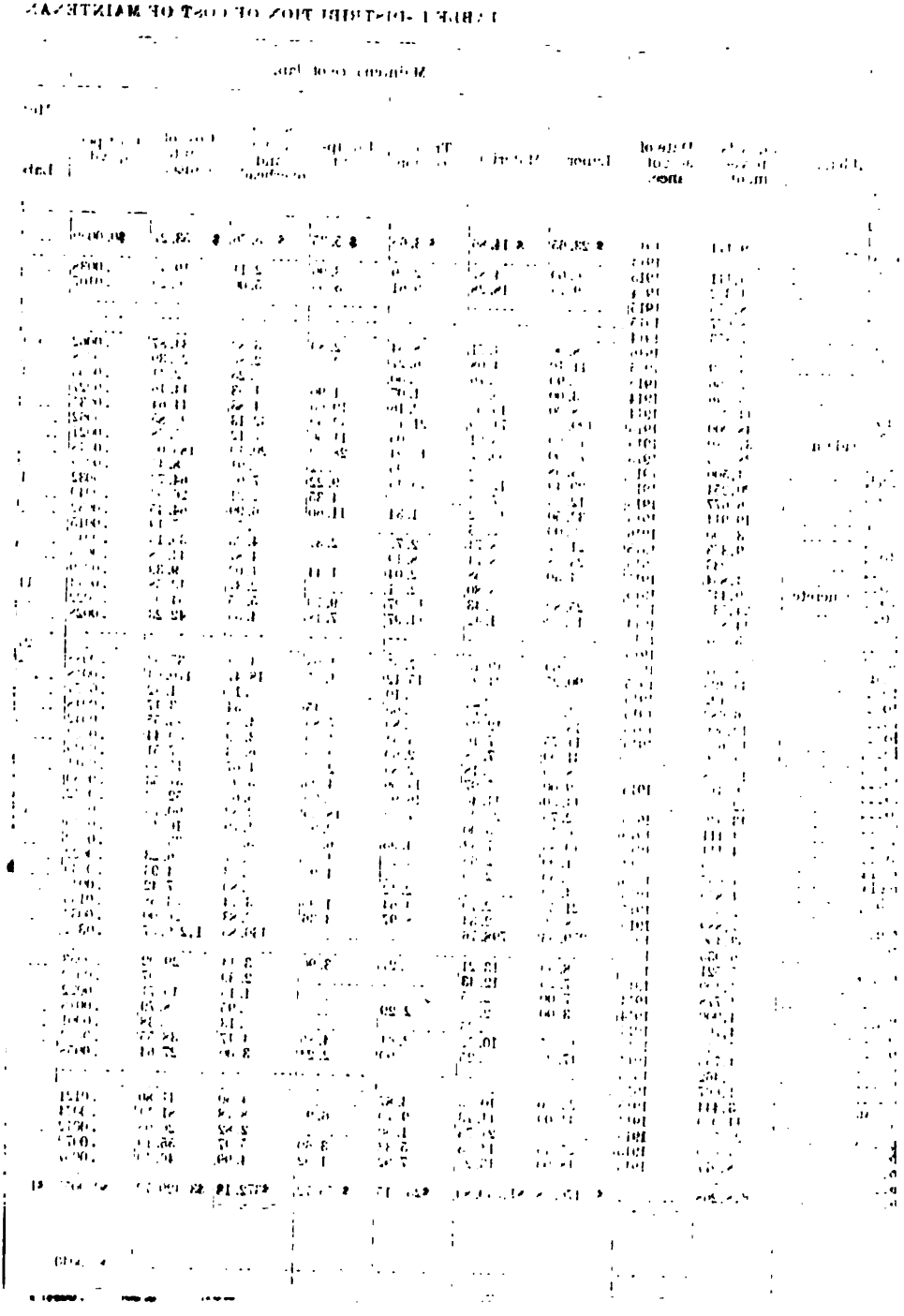
The efficiency attained by the first Ford truck was so pronounced that in 1915 two more trucks were purchased and similarly equipped for use in other divisions. The gasoline burners used in heating the tar

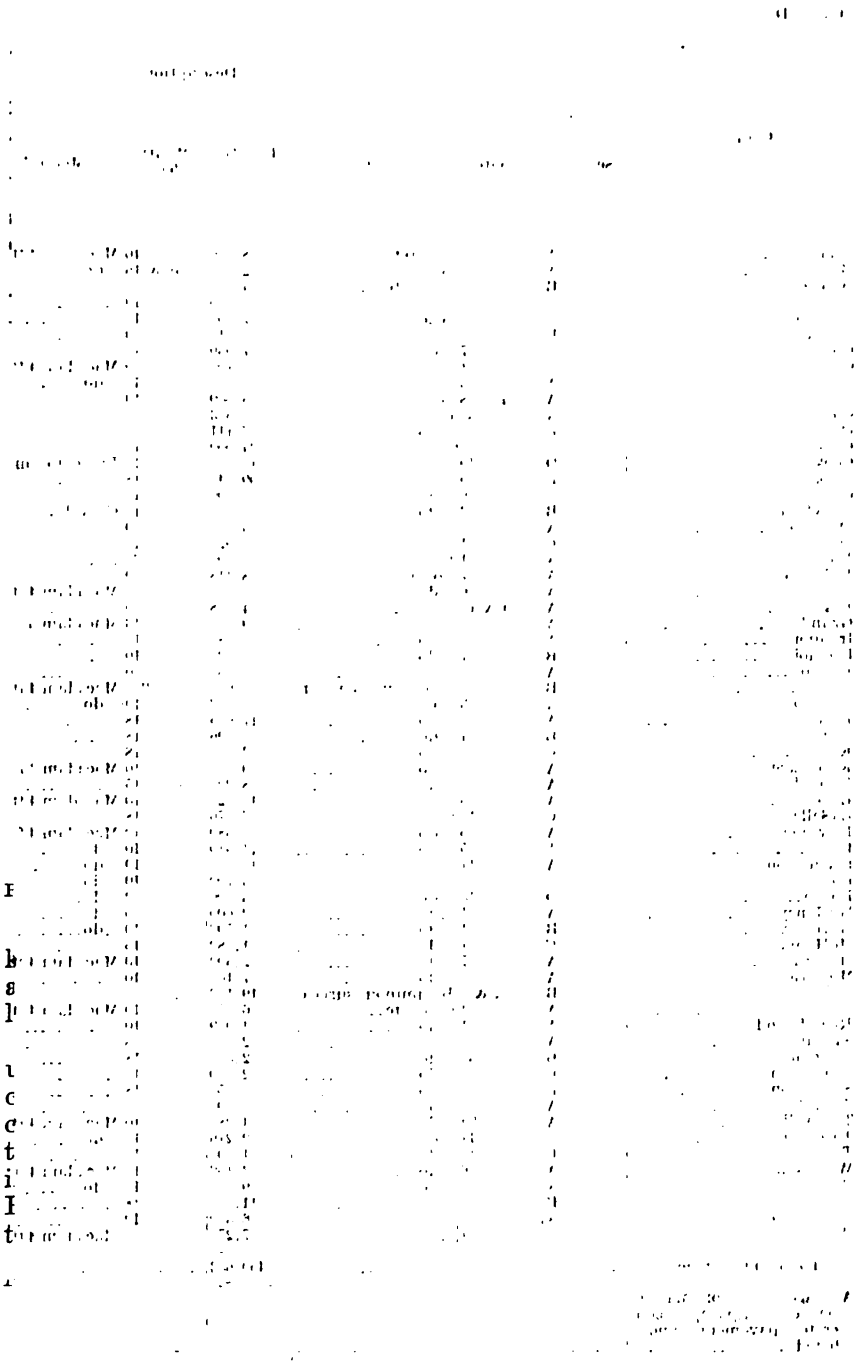
Fig. 2. Portable heating kettle and equipment used in maintaining concrete and brick pavements.

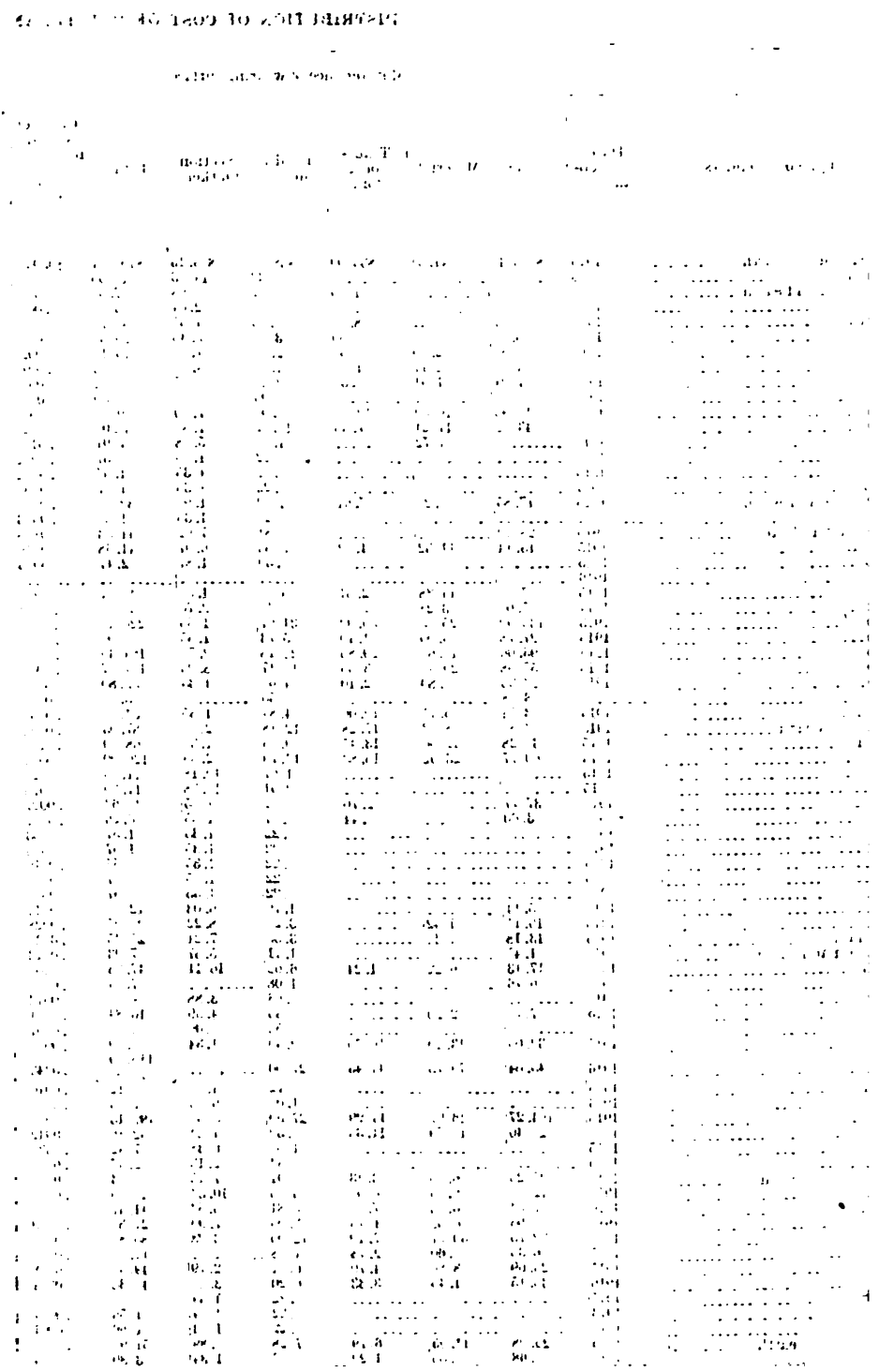
kettles on the trucks will be replaced with grates which will permit wood and coal to be used as fuel. This will result in quicker heating and lower fuel cost.

Hot bituminous material was poured into all cracks and joints until it entirely filled them and lapped over the edge of the joint or crack about one inch. Before this material cooled it was covered with coarse sand or torpedo gravel. In a few instances the buitminous material was covered lightly with Portland cement for the purpose of giving the filler in the crack the same color as the remainder of the road. However, this practice was not followed in general as it had a tendency to deaden the bituminous material.

Most of the work classified under upkeep was done usually through the county superintendent of highways. In many cases, however, when







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one of our resident engineers happened to be in the vicinity he was assigned to such work.

Records.—Upon completion of any specific job of maintenance the superintendent in charge was required to submit a cost report card. This card shown in Figure 3 gave the distribution of the cost of maintenance and upkeep. This information, together with itemized bills and receipts that were submitted, enabled the bureau to keep an accurate account of all transactions.

All records have been kept by the usual double entry system of bookkeeping. Accounts were first entered in the journals, and then posted to a ledger in which accounts were kept for all the sections of road maintained. This ledger showed at any time the amount of money which had been spent on any one section. In 1916 a large distribution ledger was opened in connection with the regular ledger. In this distribution ledger, an account was kept with each section of road, and an accurate distribution of the cost of labor, materials, equipment, etc., on the various divisions of maintenance and upkeep was recorded. The form of the ledger is about the same as the 1916 report of distribution of cost of maintenance and upkeep.

Results and Costs.—Experience has shown that the methods used have been very economical and practical thus far in the maintenance of State aid roads. It is evident, however, that as the construction of State aid roads continues and the mileage to be maintained increases, it will be necessary to modify many methods that have been used in the past, and to establish new rules which will be adaptable to the increased volume of work.

Tables I (Insert D) and II (Insert E) give the complete cost data for all roads maintained during 1915 and 1916. It will be noticed from the foregoing tables that the maintenance of concrete wearing surfaces averages about 4/10 of one cent per square yard per year, or approximately thirty dollars ($30) per mile of road. This amount includes all supervision and overhead expense that can rightly be assigned to this division of work. It will be noticed that a number of roads are three or four years old, yet the cost of maintenance proper closely approximates the cost of the first year's maintenance on other roads.

The cost of maintenance on brick surfaces has been practically negligible up to the present time, averaging in 1916, 6/100 of one cent per square yard.

The cost of upkeep which averages from $50 to $75 per mile is considerably higher than it would be if the system of roads were so connected that an organized gang could be used for cutting weeds, dragging shoulders and cleaning ditches.

It will be noted that the average cost of maintenance and upkeep for concrete roads is about $105 per mile in 1915 and $85 per mile in 1916. These seem to be reasonable figures and closely approximate the cost of similar work in other states. They indicate, at least, that this type may be maintained economically on a great many public roads. It will be noticed that the cost of upkeep for concrete and brick roads is about the same as for all roads, indicating that upkeep is practically constant, regardless of type of pavement.

(Front)

UPKEEP COST ON STATE AID ROADS.

Year.....

Local name of road.....

County..... Sec..... Route..... Nearest R. R. station.....

DESCRIPTION.

PAVEMENT.	MACADAM SHOULDERS.	CONDITION OF PAVEMENT.
Type.....	Length.....	Total length long't cracks.....ft.
Length.....	Width.....	Total length trans. cracks.....ft.
Width.....	Sq. yds.....	Total length of joints.....ft.
Sq. yds. (b).....	Condition.....	Total length all cracks and joints (a).....ft.
		Discontinuity a+b.....

MATERIALS.

BITUMINOUS MATERIAL USED.	DESCRIPTION OF OTHER MATERIALS USED.
Quantity ordered.....gallon at.....f. o. b. station.....	Sand.....
Quantity used.....gallon at.....f. o. b. station.....	Stone or gravel.....
Brand.....	
Unused material in care of.....	
Remarks.....	

MAINTENANCE ON SLAB.

Date.	Cost of material used.					Cost of labor.		Cost of transportation.						Total.
	Sand.	Bitumen.	Coal.	Gas for heating.	Hardware.	Skilled.	Common.	Storage.	Teaming.	Freight.	Gas, oil, repairs.	Labor.	Dep. on equipment.	
.....														
.....														
.....														
.....														
.....														
Total cost														
Cost per sq. yd.														

Fig. 3.

(Back) COST OF UPKEEP ON ROADSIDES AND DITCHES.

Date.	Macadam shoulders.				Earth shoulders.				Ditches and drains.				Vegetation.			
	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.
Total cost																

Date.	Cleaning.				Culverts.				Bridges.				Summation of cost.	
	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Maintenance on slab	
													Macadam shoulders	
													Earth shoulders	
													Ditches and drains	
													Vegetation	
													Cleaning	
													Culverts	
Total cost													Bridges	
													Supervision	
													Grand total cost	

*Charged to State road and bridge fund. "Fill this card out complete in ink." Fix depreciation on Ford truck, $2.00 per mile of pavement maintained, and portable heating kettles, $1.00 per mile of pavement maintained.

Remarks:

Work done by .....
In charge

Approved .....
Maintenance engineer

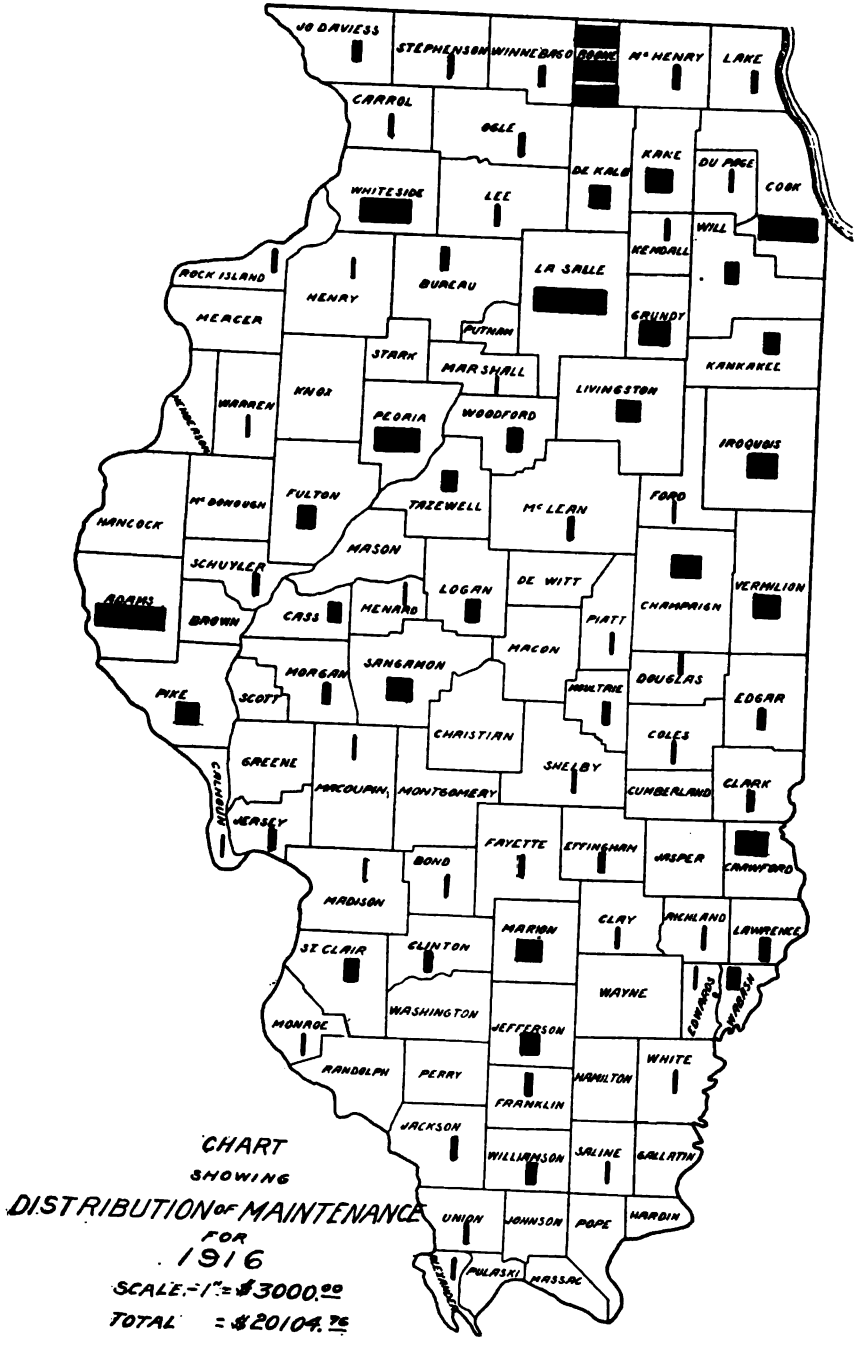

JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
Mc HENRY
LAKE
CARROL
OGLE
DE KALB
KANE
DU PAGE
COOK
WHITESIDE
LEE
WILL
KENDALL
ROCK ISLAND
HENRY
BUREAU
LA SALLE
MERCER
GRUNDY
PUTNAM
STARK
MARSHALL
KANKAKEE
KNOX
LIVINGSTON
WARREN
PEORIA
WOODFORD
IROQUOIS
HENDERSON
Mc DONOUGH
FULTON
TAZEWELL
Mc LEAN
FORD
HANCOCK
MASON
SCHUYLER
LOGAN
DE WITT
VERMILION
ADAMS
BROWN
CASS
MENARD
PIATT
CHAMPAIGN
MACON
MORGAN
SANGAMON
DOUGLAS
EDGAR
PIKE
SCOTT
MOULTRIE
CHRISTIAN
COLES
GREENE
SHELBY
CLARK
CALHOUN
MACOUPIN
MONTGOMERY
CUMBERLAND
JERSEY
FAYETTE
EFFINGHAM
JASPER
CRAWFORD
BOND
MADISON
MARION
CLAY
RICHLAND
LAWRENCE
ST CLAIR
CLINTON
WAYNE
EDWARDS
WABASH
WASHINGTON
JEFFERSON
MONROE
RANDOLPH
PERRY
HAMILTON
WHITE
FRANKLIN
JACKSON
WILLIAMSON
SALINE
GALLATIN
UNION
JOHNSON
POPE
HARDIN
ALEXANDER
PULASKI
MASSAC
CHART
SHOWING
DISTRIBUTION OF MAINTENANCE
FOR
1916
SCALE.-1"=$3000.00
TOTAL =$20104.76

Fig. 4.

An examination of the table of costs shows that the total cost of maintenance and upkeep for the year 1915 amounts to about one per cent of the first cost of construction and for 1916 to 0.75 per cent. The supervision and overhead expense, which includes the salary and expenses of the maintenance engineer, of his assistants and that portion of the division engineers' time which is chargeable to maintenance work, amounts in 1915 to 10.83 per cent of the money spent or 0.10 per cent of the first cost of construction and in 1916 to 16.2 per cent and 0.12 per cent, respectively. A much greater volume of work can be handled without any material increase in the cost of overhead and supervision.

TABLE III—EXPENDITURES FOR MAINTENANCE OF STATE AID ROADS BY COUNTIES FOR 1916.

Adams	$1,403.38	Lee	$ 47.69
Alexander	55.67	Livingston	436.38
Bond	23.61	Logan	273.00
Boone	2,687.70	McHenry	81.69
Bureau	115.85	McLean	82.29
Calhoun	16.50	Macoupin	50.39
Carroll	99.70	Madison	28.18
Cass	240.52	Marion	488.62
Champaign	536.94	Marshall	6.24
Clark	151.85	Menard	26.34
Clay	90.20	Monroe	45.78
Clinton	138.53	Morgan	154.85
Coles	56.03	Moultrie	142.56
Cook	1,165.39	Ogle	77.66
Crawford	601.22	Peoria	899.01
DeKalb	389.75	Piatt	26.83
Douglas	108.49	Pike	407.59
DuPage	78.63	Richland	22.92
Edgar	133.49	Rock Island	93.25
Edwards	15.48	St. Clair	228.81
Effingham	92.41	Saline	41.35
Fayette	73.66	Sangamon	483.86
Ford	9.47	Schuyler	99.50
Franklin	141.13	Shelby	51.52
Fulton	321.11	Stephenson	80.14
Grundy	569.83	Tazewell	275.51
Henry	15.23	Union	46.21
Iroquois	556.82	Vermilion	451.20
Jackson	85.56	Wabash	199.47
Jefferson	303.45	Warren	27.79
Jersey	96.74	White	9.15
JoDaviess	131.33	Whiteside	916.22
Kane	452.53	Will	242.68
Kankakee	280.83	Williamson	169.33
Kendall	77.22	Winnebago	108.21
Lake	68.82	Woodford	266.13
LaSalle	1,441.25		
Lawrence	190.09	Total	$20,104.76

TOWNSHIP ROAD WORK UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

The Bureau of Maintenance has made a special effort to serve in every possible capacity all township and road district officials who have requested information concerning road matters other than State aid. A great many inquiries pertaining to some particular phase of road law or to construction work have been answered by letter. Many other questions concerning road problems have required a special study of the local conditions involved. This has made necessary an inspection of the work and a consultation with the officials concerning the most economical and efficient procedure under the specific circumstances. In connection with some special pieces of work which the various communities had under

contemplation a number of requests for expert engineering supervision and also for the furnishing of the required road equipment have been received. All of such inquiries have been answered or complied with in detail, in accordance with the rules prescribed by the State Highway Commission and in compliance with the best known principles of engineering.

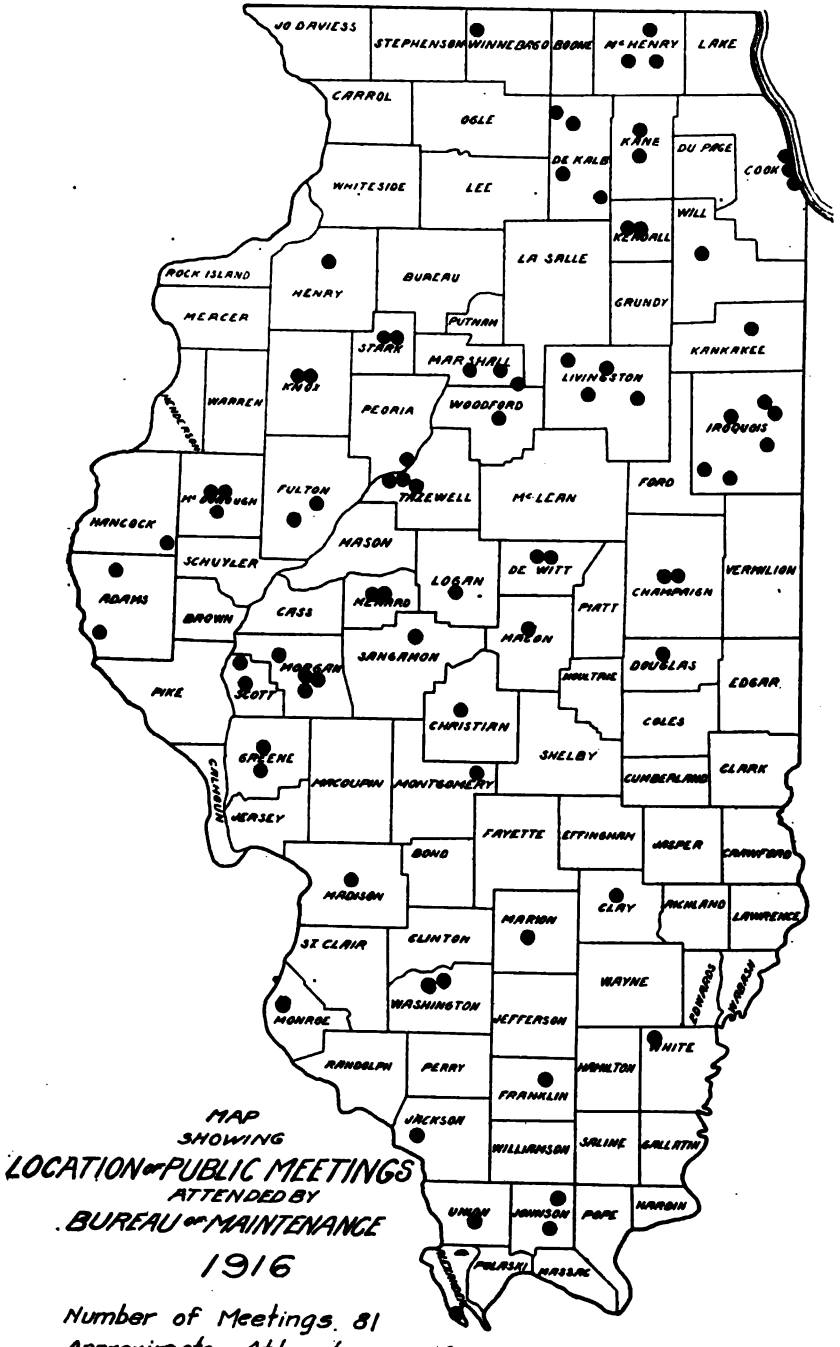
It is impossible to estimate the value of road work actually directed by correspondence from this department. Special attention has been given to the townships which have secured crushed stone from the penitentiaries. While it was not possible to supervise construction work at all points where such material was used, special intsructions concern-

Fig. 5. Eye sores on our public highways.

ing the use of the crushed stone have been issued from time to time which have served to insure the performance of such work in accordance with the highest standards of construction.

Prices of various road materials have also been secured and this information given out to local road officials where it would be of most value. Bulletins have been issued and portions of the law have been compiled and sent out to aid township officials in handling more effectively the road work under their jurisdiction.

Numerous inquiries have been received concerning road improvement which necessitated a personal interview with the interested officials. Many inspections were necessary merely to point out to the township and road district officials the most practical way of handling



MAP
SHOWING
LOCATION of PUBLIC MEETINGS
ATTENDED BY
BUREAU of MAINTENANCE
1916

Number of Meetings. 81
Approximate Attendance 18000

Fig. 6.

Fig. 7. A macadam road badly in need of maintenance.

Fig. 8. A macadam surface which will soon be ruined if not maintained.

their work and to offer suggestions for their consideration. In a number of cases some of the inquiries required two or three days work on the ground. Other inspections were made to examine road material and to advise how it should be used.

There were many inquiries of a general nature which required a special meeting of all road officials and interested taxpayers. At these meetings talks were made on different phases of road work, and stereoptican pictures were shown to aid in creating community sentiment in favor of a form of road improvement best suited to the local conditions.

A great deal of attention has been given to these special meetings with the apparent result that the communities visited have been aroused to an interest in some definite road improvement. These meetings have also aided materially in educating the public concerning the fundamental principles of road construction and maintenance, and have also served to show the work which is being done in other sections of the country.

Fig. 9. A bituminous macadam road in need of a surface treatment.

Through cooperation with the State Farmers' Institute a very large number of meetings have been attended and addressed. In this way the department has gotten into touch with the farmers and business men who were assembled to discuss matters of vital importance to the welfare of the various communities. At nearly all of these meetings, the road topic occupied part of the program and at the meetings attended the representatives of this department made a special effort to explain the work of the State Highway Department as well as to discuss road construction in general. Frequently the lectures have been illustrated with stereoptican views with the result that the interest of the public was greatly enlivened by specific examples of modern road construction.

Attention has been called to the fact that the State Highway Department was ready and willing at all times when requested by road officials, to provide engineers trained in road and bridge construction

Fig. 10. A bituminous macadam road which has suffered from lack of maintenance. A little money spent in time would have saved this condition.

Fig. 11. A township road built under State supervision. Note extensive grading.

whose services in advising counties and townships would be free of charge.

A great many applications have been received from road officials throughout the State for assistance from the department in the way of supervising the construction and furnishing the necessary equipment for handling a specific piece of road work in their township or road district. Inasmuch as assistance of this kind had been granted prior to 1913 and on account of the stimulative action that a good road has upon future road improvement in a community, the practice of furnishing expert engineering supervision and equipment for building and maintaining short sections of road in various townships and road districts was continued throughout 1913, 1914, 1915, and 1916.

The building of short sections of roads in different parts of the State under the direct supervision of the State Highway Department and with State equipment offers a splendid opportunity for experimental

Fig. 12. A macadam road protected by a surface treatment of asphaltic oil and torpedo gravel.

work and for investigating the advantages and disadvantages of various types of roads for different sections of Illinois. This work has made possible a determination of the value of many different road materials and has shown the best methods for using them.

While the cost of furnishing expert engineering supervision and the necessary road machinery for constructing short sections of road has been a small portion of the total cost of the improvement yet such work has aided very materially in starting a systematic plan of road improvement in many townships and road districts. The road thus built usually demonstrated the economic value of an improved highway and materially stimulated road construction in general.

In addition to furnishing machinery and expert supervision the Highway Commission, in many cases, has granted the use of penitentiary stone for constructing roads in the various townships and counties;

(Front)

UPKEEP COST ON STATE AID ROADS.

Year.....

Local name of road.....

County..... Sec..... Route..... Nearest R. R. station.....

DESCRIPTION.

PAVEMENT.	MACADAM SHOULDERS.	CONDITION OF PAVEMENT.
Type.....	Length.....	Total length long't cracks.....ft.
Length.....	Width.....	Total length trans. cracks.....ft.
Width.....	Sq. yds.....	Total length of joints.....ft.
Sq. yds. (b).....	Condition.....	Total length all cracks and joints (a).....ft.
		Discontinuity a÷b.....

MATERIALS.

BITUMINOUS MATERIAL USED.	DESCRIPTION OF OTHER MATERIALS USED.
Quantity ordered.....gallon at.....f. o. b. station.....	Sand.....
Quantity used.....gallon at.....f. o. b. station.....	Stone or gravel.....
Brand.....	
Unused material in care of.....	
Remarks.....	

MAINTENANCE ON SLAB.

Date.	Cost of material used.					Cost of labor.		Cost of transportation.						Total.
	Sand.	Bitumen.	Coal.	Gas for heating.	Hardware.	Skilled.	Common.	Storage.	Teaming.	Freight.	Gas, oil, repairs.	Labor.	Dep. on equipment.	
.....														
.....														
.....														
.....														
.....														
Total cost														
Cost per sq. yd.														

Fig. 3.

(Back) COST OF UPKEEP ON ROADSIDES AND DITCHES.

Date.	Macadam shoulders.				Earth shoulders.				Ditches and drains.				Vegetation.			
	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.
Total cost																

Date.	Cleaning.				Culverts.				Bridges.				Summation of cost.	
	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Skilled labor.	Labor and teaming.	Materials.	Equipment.	Maintenance on slab	
													Macadam shoulders	
													Earth shoulders	
													Ditches and drains	
													Vegetation	
													Cleaning	
													Culverts	
Total cost													Bridges	
													Supervision	
													Grand total cost	

*Charged to State road and bridge fund. "Fill this card out complete in ink." Fix depreciation on Ford truck, $2.00 per mile of pavement maintained, and portable heating kettles, $1.00 per mile of pavement maintained.

Remarks:

Work done by .....
In charge

Approved .....
Maintenance engineer

department, the efficiency of handling construction on a larger scale has been shown.

It is evident that when the main roads of a county are to be improved under a bond issue, the contract system is more desirable and more efficient than the day labor method of construction.

However, in townships and counties that are very backward in promoting road improvement, there are numerous short stretches of roads to be improved each year, and in such cases it has been found that the day labor method is much superior. These communities are quite often handicapped financially, and are unable to purchase the necessary road machinery or to employ competent engineering supervision. Therefore, the assistance offered by the State Highway Department in furnishing equipment and supervision aids materially in promoting first class road construction in a great many districts that otherwise would not improve their roads.

Fig. 16. East Eldorado Township, Saline County. Spreading sand cushion and laying brick.

During the years 1914, 1915 and 1916 many townships secured some assistance from the county superintendent of highways, and it has been noticeable that since the establishment of the office of county superintendent of highways fewer inquiries concerning road work have come to this department. In many counties the county superintendent has been unable to secure suitable machinery, and, therefore, through his advice many townships have asked this department for engineering assistance and for the use of road machinery. In all work under the supervision of this department an extra effort has been made to cooperate with the county superintendent by handling the work in accordance with his ideas, and at the same time following the rules prescribed by the Chief State Highway Engineer and the State Highway Commission.

During the period covered by this report a great deal of attention has been given to the maintenance of various sections of improved roads.

The maintenance of all types of roads has been neglected in the past and the aim of this department has been to educate the public to an appreciation of the importance of adequate maintenance.

Townships have been assisted in maintenance work as in construction by the furnishing of engineering supervision and road machinery. The selection of proper grades of material and proper methods of maintenance has been emphasized. The efficiency of this service has been demonstrated and the township taxpayers have reaped the benefit by the conservation of roads which cost thousands of dollars to build.

This department is being called upon constantly by various townships and counties and road associations of the State to give some definite figures of the cost of construction and maintenance of various types of roads. In view of this condition it has been necessary to construct as many different types of roads as possible and to use various methods in order to determine the most economical type and methods under any

Fig. 11. Bottom Road, LaSalle Township, LaSalle County. Showing flood conditions. Before improvement.

specific condition. In view of this fact in a number of cases preference has been given to those townships or road districts that wished to build a type of road different from the ordinary requirements of the average township. Where townships desired to make such experiments it was of great benefit for this department to do their work on a day labor basis. Under such conditions more accurate cost data could be kept and often times the road completed in a more satisfactory manner than if let by contract.

In a number of cases townships were interested in the establishment of convict camps for road construction. When convict labor is used it is not desirable to contract for the work and in such cases it is necessary

for this department to furnish the general supervision and the equipment necessary for such construction.

In a number of places where the department has been requested to take charge of road construction, it has been found that portions of the work, such as hauling or excavation, could be handled much cheaper by contract than by day labor. In such cases the awarding of portions of the work by contract was urged thereby assuring low cost and speedy completion of the work. The local facilities for handling portions of such work quite often were inadequate and consequently the awarding of a portion of the work by contract was considered desirable.

In the construction of many sections of road the services of this department were requested late in the construction season, and quite often the rush of placing contracts for material, and of organizing a working force to complete the road before the close of the season has not always been productive of economy. Therefore on a few jobs the cost has not been as low as it might have been if sufficient time had been allowed

Fig. 18. Bottom road. After improvement. Built of concrete by day labor under supervision of State.

to purchase properly the material and to organize efficiently the constructing forces.

The improvement of a large number of short, scattered sections of roads has necessarily increased the cost somewhat, as about the time the organization was perfected the work was completed. There has always been a large number of different types of roads and the shifting of equipment together with the changing of engineers from one type of improvement to another somewhat affected the cost.

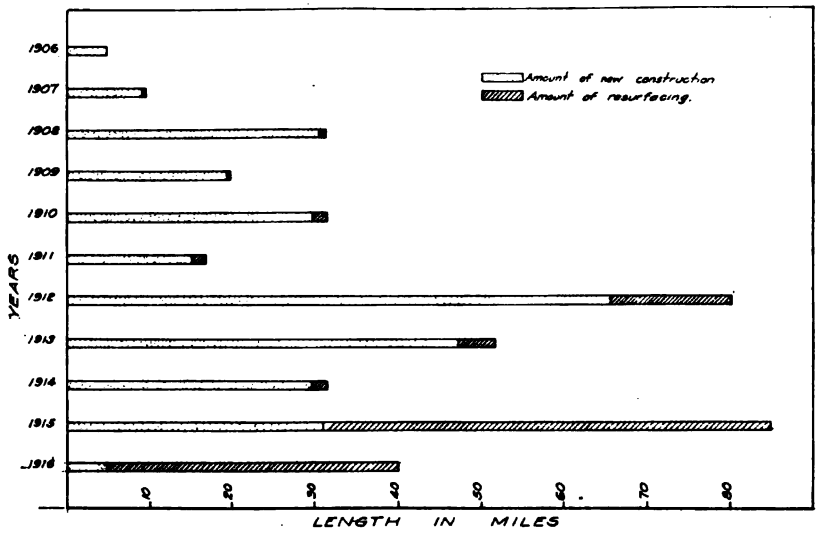
However in spite of all these unfavorable conditions the cost of this work compares favorably with and in a majority of cases is considerably less than the cost of constructing work by private contract under far more favorable circumstances.

TABLE IV—TOWNSHIP ROAD CONSTRUCTION HANDLED BY THE STATE HIGHWAY DEPARTMENT IN 1915.

	Total value of work.	Miles of new construction.	Miles resurfaced and rebuilt.	Total miles constructed.
Township road work supervised by State Highway Department and on which State machinery was used	$228,997.46	32.2	52.8	85.0
State aid road work on which State machinery was used	33,000.00			

TABLE V—COST TO STATE HIGHWAY DEPARTMENT FOR TOWNSHIP ROAD CONSTRUCTION IN 1915.

Estimated depreciation of all equipment for 1915, 12 per cent		$4,390.68
Freight and repairs on all equipment for 1915		2,166.78
Operating expense paid by State Highway Department in 1915		202.62
Total expense on equipment in 1915		$6,760.08
Cash received for rental on equipment for 1915 (used on State aid road construction)		675.38
Total cost to State Highway Department for	Equipment	$6,084.70
	Direct supervision of township road construction	6,531.77
	Engineering and overhead, on township road construction	2,655.00
Total cost to State Highway Department for township road work done in 1915		$15,271.47
Total cost to State Highway Department in per cent of work done	Equipment	2.66%
	Direct supervision	2.85%
	Engineering and overhead	1.16%
Total cost to State Highway Department in per cent of work done in 1915		6.67%
Total cost to State Highway Department, in per cent of work done, including only money actually paid out during 1915 for engineering, overhead, supervision and repair on equipment		4.75%



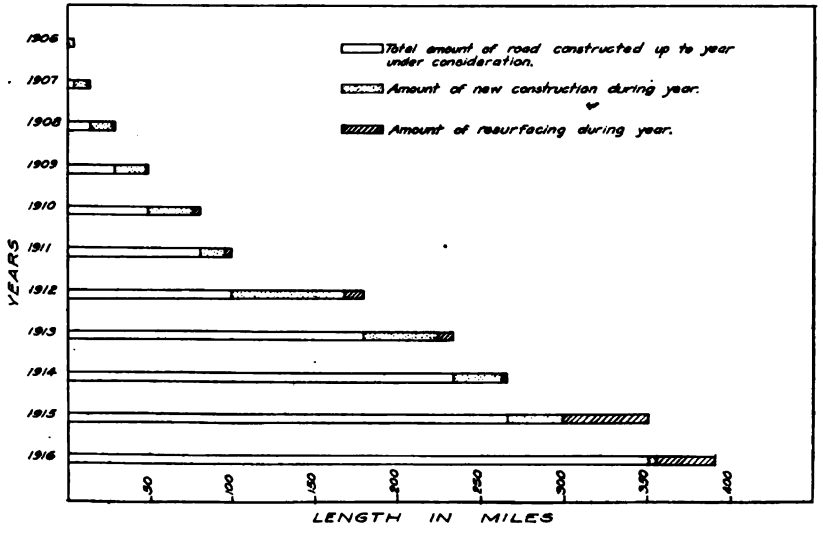


Fig. 19. Charts showing mileage of township roads built under supervision of the State Highway Department.

TABLE VI—COST OF WATERBOUND MACADAM ROADS CONSTRUCTED DURING 1913, UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

	Palestine.	Somonauk—County Line Road.	Somonauk—Fuller Road.	Somonauk—Hamp White Road.	Hindsboro—Oakland Road.	Hindsboro—Tuscola Road.	Kinsman.	Genesco.	Carbondale—Cemetery Road.	Carbondale—Etherton Road.
Amount of pavement laid, sq. yds	4,604	12,126	2,020	3,533	12,067	12,222	6,039	2,333	3,840	6,933
Width of pavement, ft	12 & 16	*12	10	12	10	10	16	12	12	12
Amount of stone used, cu. yds	962	4,727	716	1,516	3,680	3,990	2,027	732	1,215	2,551
COST OF LABOR AND SUPPLIES.										
Engineering and inspection	$ 25.00	$ 202.50	$146.50	$ 72.00	$ 240.40	$ 247.10	$ 189.00	$100.00	$ 65.50	$ 196.50
Superintendence	152.85	190.13	18.00	46.65	124.20	76.80	240.50	.....	288.35	255.80
Excavation	37.50	208.98	40.70	40.00	133.20	172.20	58.45	59.25	144.10	469.85
Shaping road bed and trimming shoulders										
Loading stone, including rehandling	253.35	2,223.32	9.10	10.50	135.25	45.00	114.84	98.39	161.30	449.95
Hauling stone			295.07	617.83	1,200.70	1,381.15	463.24	380.62	329.77	991.40
Spreading stone	88.50	341.95	86.91	123.76	241.70	281.30	189.25	63.13	132.30	397.45
Rolling and sprinkling	26.50	178.75	127.20	70.25	144.50	96.10	41.70	85.22	85.20	265.10
Watchman and miscellaneous labor	53.35	92.01	49.97	36.00	256.05	171.75	83.63	20.00	50.00	116.90
Coal, oil and supplies	39.71	202.99	55.99	42.09	301.61	306.41	57.54	30.00	25.00	66.28
Freight on stone (including demmurage)	1,064.76	2,731.87	525.90	947.50	†4,838.14	†4,900.51	1,147.98	713.72	759.50	1,910.71
Depreciation or rental on equipment	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	$1,741.52	$6,462.50	$1,355.34	$2,006.58	$7,615.75	$7,678.32	$2,586.13	$1,550.34	$2,041.02	$5,119.94
COST PER CUBIC YARD FOR PLACING STONE.										
Loading stone including rehandling	$0.263	$0.470	$0.013	$0.414	$0.037	$0.011	$0.056	$0.135	$0.133	$0.175
Hauling stone			0.412		0.327	0.345	0.225	0.520	0.280	0.388
Spreading stone	0.092	0.093	0.101	0.081	0.065	0.071	0.092	0.086	0.109	0.755
Rolling and sprinkling	0.028	0.038	0.178	0.046	0.039	0.024	0.020	0.116	0.070	0.104
Watchman and miscellaneous labor	0.056	0.019	0.069	0.024	0.070	0.043	0.041	0.027	0.041	0.046
Coal, oil and supplies	0.041	0.048	0.078	0.027	0.062	0.077	0.028	0.041	0.021	0.026
Total	$0.480	$0.668	$0.851	$0.592	$0.620	$0.571	$0.462	$0.925	$0.654	$0.894
COST PER SQUARE YARD FOR FINISHED ROADS.										
Engineering and inspection	$0.006	$0.017	$0.072	$0.020	$0.020	$0.020	$0.031	$0.043	$0.017	$0.028
Superintendence	0.009	0.017	0.020	0.011	0.011	0.014	0.010	0.026	0.037	0.068
Shaping roadbed and trimming shoulders										

* Some variations, 10-16 ft. † Includes cost of stone

(Continued on next page.)

TABLE VI—Continued.

Cost per Square Yard for Finished Roads.	Palestine.	Somonauk—County Line Road.	Somonauk—Fuller Road.	Somonauk—Hamp White Road.	Hindsboro—Oakland Road.	Hindsboro—Tuscola Road.	Kinsman.	Genesco.	Carbondale—Cemetery Road.	Carbondale—Etherton Road.
Loading stone including rehandling	$0.055	$0.184	$0.094	$0.003	$0.011	$0.004	$0.018	$0.042	$0.042	$0.065
Hauling stone			0.146	0.175	0.100	0.110	0.077	0.164	0.086	0.143
Spreading stone	0.019	0.035	0.043	0.035	0.020	0.023	0.031	0.027	0.034	0.057
Rolling and sprinkling	0.005	0.015	0.063	0.020	0.011	0.011	0.007	0.037	0.022	0.039
Watchman and miscellaneous labor	0.012	0.007	0.025	0.010	0.021	0.014	0.014	0.009	0.013	0.017
Coal, oil and supplies	0.009	0.018	0.027	0.012	0.025	0.025	0.010	0.013	0.007	0.009
Freight on stone	0.231	0.225	0.260	0.274	0.401	0.401	0.190	0.306	0.198	0.276
Depreciation or rental on equipment										
Total (excluding excavation)	$0.346	$0.518	$0.660	$0.560	$0.620	$0.622	$0.388	$0.667	$0.456	$0.702

TABLE VI—Concluded.

	Carbondale—Murphysboro Road.	Carbondale—North Marion Road.	Herscher.	Fairbury.	Troy—Black Jack Road.	Nameoki.	Baldwin.	Blairsville.	Brocton—Hindsboro.
Amount of pavement laid, sq. yds.	6,793	9,600	10,944	1,552	5,667	13,166	6,711	5,333	73,489
Width of pavement, ft.	12 & 16	12	12 & 63	16	12	16	10, 12 & 16	12	10
Amount of stone used, cu. yds.	3,059	2,700	3,468	733	1,811	4,559	2,198	1,585	25,473
COST OF LABOR AND SUPPLIES.									
Engineering and inspection									
Superintendence		$ 132.00	$ 248.00	$ 70.00	$ 308.00	$ 182.00	$ 158.00	$ 169.50	$ 2,276.42
Excavation	$389.70	351.25	272.78	121.50	251.60	585.39	126.77	†973.82	306.85
Shaping roadbed and trimming shoulders		361.70	206.43	92.10	277.40	699.55	34.20	462.06	671.10
Loading stone, including rehandling		755.60	374.00	40.50	182.80	2,278.50	309.80	452.90	3,046.03
Hauling stone		368.00	594.00	187.25	1,186.30		317.80	668.31	14,437.29
Spreading stone		414.60	302.08	108.45	101.20	400.25	201.50	279.65	2,102.04
Rolling and sprinkling		175.00	174.50	83.70	191.15	601.00	151.35	251.00	1,600.19
Watchman and miscellaneous labor		157.80	104.66	10.50	59.20	222.00	44.50	687.32	670.07
Coal, oil and supplies		151.81	124.33	30.30	61.55	62.31	48.50	46.05	428.42

Freight on stone (including demmurage)		2,337.69	2,660.18	551.42	1,569.90	4,570.40	1,342.34	1,483.43	‡30,312.82
Depreciation or rental on equipment									
Total	$**3,200.00	$5,205.45	$5,060.96	$1,295.72	$4,189.10	$9,601.40	$2,734.76	$5,474.04	$55,851.23
COST PER CUBIC YARD FOR PLACING STONE.									
Loading stone including rehandling	$0.141	$0.280	$0.108	$0.055	$0.101	$0.050	$0.141	$0.288	$0.120
Hauling stone	0.284	0.137	0.171	0.256	0.655		0.144	0.422	0.567
Spreading stone	0.082	0.153	0.087	0.148	0.056	0.088	0.092	0.176	0.083
Rolling and sprinkling	0.03)	0.065	0.050	0.114	0.106	0.045	0.069	0.159	0.063
Watchman and miscellaneous labor	0.054	0.058	0.030	0.014	0.033	0.048	0.020	0.249	0.025
Coal, oil and supplies		0.056	0.033	0.041	0.034	0.013	0.022	0.029	0.017
Total	$**0.591	$0.749	$0.482	$0.628	$0.985	$0.694	$0.488	$1.321	$0.875
COST PER SQUARE YARD FOR FINISHED ROAD.									
Engineering and inspection									
Superintendence	$0.020	$0.014	$0.022	$0.045	$0.054	$0.014	$0.024	$0.032	$0.031
Shaping roadbed and trimming shoulders	0.021	0.038	0.019	0.060	0.049	0.053	0.005	0.050	0.009
Loading stone including rehandling	0.045	0.078	0.034	0.026	0.032	0.173	0.046	0.085	0.041
Hauling stone	0.091	0.038	0.054	0.121	0.209		0.047	0.125	0.196
Spreading stone	0.026	0.043	0.028	0.070	0.018	0.030	0.030	0.052	0.029
Rolling and sprinkling	0.009	0.018	0.016	0.054	0.034	0.045	0.022	0.047	0.022
Watchman and miscellaneous labor	0.010	0.016	0.009	0.007	0.010	0.017	0.007	0.097	0.009
Coal, oil and supplies		0.016	0.011	0.020	0.011	0.005	0.007	0.009	0.006
Freight on stone	0.180	0.243	0.245	0.355	0.277	0.347	0.200	0.280	0.412
Depreciation or rental on equipment									
Total (excluding excavation)	$**0.402	$0.504	$0.438	$0.758	$0.694	$0.684	$0.388	$0.777	$0.755

‡ 3,000 ft. of extra grading complete for stone.
** An approximate estimate as final reports were incomplete.

TABLE VII—COST OF CONCRETE ROADS CONSTRUCTED DURING 1913 UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

	LaSalle.	Highland.	Jacksonville.	Shirley.	Springfield.	LeRoy.	Edwardsville—Troy Road.	Edwardsville—Fair Grounds Road.	Chandlersville.
Amount of pavement laid, square yards	10,663	6,680	2,148	6,737	8,566	5,125	10,366	6,470	3,216
Thickness of pavement, inches	6	6	6	[illegible]	6 & 7	6	6	6	6
Width of pavement, feet	18 & 20	9	18	[illegible]	9 & 18	9	15	15	16
Cost of cement per barrel f. o. b. siding	†$1.06	$1.40	$1.285	$1.29	.....	$1.29	.....	.....	.....
Cement per square yard of pavement, barrels	.29	.29	.28	.29	.....	.24	.....	.....	.25
COST OF LABOR AND SUPPLIES.									
Engineering and inspection	.....	.....	.....	.....	.....	.....	.....	.....	.....
Superintendence	$ 240.00	$ 202.00	$ 87.00	$ 175.00	$ 405.00	$ 35.00	.....	.....	.....
Excavation, shaping road bed and trimming shoulders	1,682.60	1,427.50	231.94	205.00	2,490.07	120.00	.....	.....	$25.00
Loading sand and stone	.....	78.00	61.78	.....	187.25	2.00	.....	.....	.....
Hauling sand, stone and cement	1,798.98	1,402.00	158.16	658.05	1,295.21	793.80	.....	.....	.....
Mixing and placing concrete, setting forms and filling joints	1,415.40	655.35	231.37	983.00	1,245.07	543.90	.....	.....	.....
Covering, seasoning and cleaning concrete	.....	45.88	.....	50.00	.....	.....	.....	.....	.....
Watchman and miscellaneous labor	1,238.50	234.45	112.46	.....	567.28	1.00	.....	.....	.....
Sand and stone f. o. b. siding, including demurrage	3,352 45	2,182.32	573.17	1,783.92	2,582.05	1,359.80	.....	.....	.....
Cement f. o. b. siding, including demurrage	3,301.00	2,794.32	833.08	2.394.88	3,055.71	1,602.47	.....	.....	.....
Expansion joints f. o. b. siding	299.00	248.32	28.00	137.00	253.28	.....	.....	.....	80.00
Reinforcing steel f. o. b. siding	.....	.....	5.00	.....	.....	.....	.....	.....	.....
Coal and oil for mixer and miscellaneous supplies	224.49	99.54	21.10	43.00	98.74	150.00	.....	.....	.....
Forms and other lumber	79.74	40.35	16.61	50.00	61.80	.....	.....	.....	.....
Depreciation or rental on equipment	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	$13,632.16	$9,413.03	$2,369.67	$6,480.85	$12,241.46	$4,617.97	$12,231.00	$8,900.00	$3,001.00
Contract price	.....	.....	.....	.....	.....	.....	$12,231.00	*$8,900.00	$2,896.00
COST PER SQUARE YARD OF LABOR AND SUPPLIES.									
Engineering and inspection	.....	.....	.....	.....	.....	.....	.....	.....	.....
Superintendence	$0.023	$0.030	$0.040	$0.026	$0.047	$0.007	.....	.....	.....
Excavation, shaping road bed and trimming shoulders and side roads	0.158	0.214	0.108	0.030	0.291	0.023	.....	.....	.....
Loading sand and stone	.....	0.012	0.028	.....	0.022	0.001	.....	.....	.....
Hauling sand, stone and cement	0.169	0.210	0.079	0.097	0.151	0.155	.....	.....	.....
Mixing and placing concrete, setting forms and filling joints	0.133	0.098	0.108	0.146	0.145	0.106	.....	.....	.....
Covering, seasoning and cleaning concrete	.....	0.007	.....	0.008	.....	.....	.....	.....	.....
Watchman and miscellaneous labor	0.116	0.035	0.052	.....	0.066	.....	.....	.....	.....
Sand and stone f. o. b. siding, including demurrage	0.314	0.326	0.269	0.265	0.301	0.267	.....	.....	.....
Cement f. o. b. siding, including demurrage	0.310	0.418	0.388	0.355	0.357	0.313	.....	.....	.....
Expansion joints f. o. b. siding	0.028	0.037	0.013	0.020	0.030	.....	.....	.....	.....

Reinforcing steel f. o. b. siding			0.002						
Coal and oil for mixer and miscellaneous supplies	0.021	0.015	0.009	0.007	0.012	0.029			
Forms and other lumber	0.008	0.006	0.008	0.008	0.007				
Depreciation or rental on equipment									
Total	$1.280	$1.408	$1.104	$0.962	$1.429	$0.901	$1.18	$1.33	$0.933
Cost per square yard excluding excavation	$1.122	$1.194	$0.996		$1.138				

* Includes 2,000 feet of curb (6x12).
† Estimated.

TABLE VIII—COST OF REPAIR WORK DURING 1913, UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

	Bushnell.*	Beardstown.	Whitehall.	Collinsville—East St. Louis Road.	Shirley.	Fairbury.	Salem.
Amount of pavement repaired, sq. yd	1,121	10,089	4,720	13,950	12,800	2,400	3,520
Width of pavement, ft.	12	12	20	16 & 20	12	12	12
Stone and gravel used, cu. yds.	303	157	454	355	464	77	177
Treated with bituminous binder, sq. yd	1,121	10,089	4,720	13,950			
Amount of bituminous binder used, gals.	2,534	4,900	7,700	6,415			
COST OF LABOR AND SUPPLIES.							
Engineering and inspection							
Superintendence	$ 64.00	$ 72.00	$ 42.50	$135.00	$ 90.00	$ 7.50	$95.00
Excavation	70.20		6.00				
Shaping road bed and trimming shoulders, etc.	3.80		27.00	16.25		8.10	
Loading stone, including rehandling	44.53	14.05	47.00	49.25	30.80		11.80
Hauling stone, including rehandling	112.80	71.45	214.00	144.00	178.10	26.60	49.20
Spreading stone	63.57	35.40	67.00	169.00	103.60	15.00	49.25
Rolling and sprinkling	22.50	55.70	54.00	238.75	70.90	15.00	35.00
Watchmen and miscellaneous labor	40.45	58.55	35.00	212.65	8.85		22.00
Coal, oil and supplies	49.10	19.21	41.77	49.15	22.37	10.00	6.83
Heating bituminous binder	20.10	22.90	59.00	31.25			
Hauling and spreading bituminous binder	55.99	61.20	39.75	72.95			
Cost of bituminous binder f. o. b. siding	244.81	353.42	405.67	744.14			
Freight on stone (including cost of stone or gravel, if any)	527.08	241.27	380.62	717.69	224.54	93.06	69.00
Depreciation or rental on equipment							
Total	$1,318.93	$1,005.15	$1,419.31	$2,580.08	$729.16	$175.26	$338.08

* New construction. Bituminous macadam.

TABLE VIII—Concluded.

	Bushnell.*	Beardstown.	Whitehall.	Collinsville—East St. Louis Road.	Shirley.	Fairbury.	Salem.
COST PER CUBIC YARD FOR PLACING STONE.							
Loading stone	$0.147	$0.090	$0.104	$0.109	$0.066	.....	$0.067
Hauling stone	0.372	0.455	0.471	0.317	0.386	$0.346	0.278
Spreading stone	0.210	.....	0.124	0.371	0.223	0.198	0.279
Rolling and sprinkling	0.074	.....	0.119	.....	0.153	0.198	0.198
Watchmen and miscellaneous labor	0.133	.....	0.077	.....	0.019	.....	0.124
Coal, oil and supplies	0.126	.....	0.092	.....	0.048	0.130	0.038
Total	$1.062	$0.545	$0.987	$0.797	$0.895	$0.872	$0.984
COST PER GALLON FOR APPLYING BITUMINOUS BINDER.							
Heating bituminous binder	$0.008	$0.004	$0.008	$0.005	.....	.....	.....
Hauling and spreading bituminous binder	0.022	0.012	0 005	0.006	.....	.....	.....
Total	$0.030	$0.016	$0.013	$0.011	.....	.....	.....
COST PER SQUARE YARD FOR FINISHED ROAD.							
Engineering and inspection	.....	.....	.....	.....	.....	.....	.....
Superintendence	$0.057	$0.007	$0.009	$0.010	$0.007	$0.008	$0.027
Shaping road bed and trimming shoulders	0.003	.....	0.006	0.001	.....	0.003	.....
Loading stone	0.040	0.001	0.010	0.004	0.002	.....	0.003
Hauling stone	0.101	0.007	0.045	0.010	0.014	0.011	0.014
Spreading stone	0.057	0.003	0.012	0.012	0.008	0.006	0.014
Rolling and sprinkling	0.020	0.005	0.011	0.017	0.006	0.006	0.010
Watchman and miscellaneous labor	0.036	0.006	0.008	0.015	0.001	.....	0.007
Coal, oil and supplies	0.044	0.002	0.009	0.003	0.002	0.004	0.002
Applying bituminous binder	0.068	0.008	0.022	0.008	.....	.....	.....
Cost of bituminous binder	0.218	0.085	0.096	0.058	.....	.....	.....
Freight on stone	0.470	0.024	0.081	0.051	0.018	0.039	0.019
Depreciation or rental on equipment	.....	.....	.....	.....	.....	.....	.....
Total	$1.114	$0.098	$0.299	$0.184	$0.058	$0.072	$0.096
Excavation	.....	.....	.....	.....	.....	.....	.....

* New construction. Bituminous macadam.

TABLE IX—COST OF WATERBOUND MACADAM ROADS CONSTRUCTED DURING 1914, UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

	Belmont—East Woodland.	Belmont—West Woodland.	Carbondale—DeSoto.	Carbondale—Makanda.	Carbondale—Snyder Cemetery.	Washington—Chicago East (State Line).	Washington—West.	Washington—Indiana Street.
Amount of pavement laid, sq. yd	7,124	5,280	8,734	10,534	9,734	69,424	6,555	7,582
Width of pavement, feet	12	12	12	12	12	10 & 12	10	12 & 20
Thickness, inches	10	10	10	10	10	10	10	6
Average haul, miles			1.0	2.5	1.5	2.18	1.5	½
Rate of pay per hour, teams	$0.40	$0.40	$0.40	$0.40	$0.40	$0.50	$0.50	$0.50
Rate of pay per hour, men	0.22½	0.22½	0.20	0.20	0.20	*	0.22½	0.22½
COST OF LABOR AND MATERIALS.								
Engineering and inspection								
Superintendence	$ 182.00	$ 174.00	$ 132.74	$ 283.32	$ 144.76	$ 1,407.59		$31.25
Excavation	1,192.88	233.31	1,191.90	1,271.81	1,043.98	4,756.55	$ 793.42	
Stone, f.o.b. siding	1,736.32	1,441.48	1,950.81	2,341.05	2,206.71	13,845.48	1,221.70	746.16
Bonding material, f. o. b. siding						2,825.34	240.23	326.06
Unloading stone to storage or loading direct	150.00	100.00	1,147.51	283.90	272.00	15,680.09	1,107.58	456.52
Hauling stone and bonding material	801.25	657.41		2,147.13	1,147.14			
Hauling and placing stone drains			63.70	85.50	67.50			
Hauling and placing tile drains			75.38	64.50	33.35			
Shaping and rolling subgrade, shoulders and side roads	352.00	210.61	393.65	422.05	343.45	2,261.36	142.17	28.78
Spreading stone and screenings	153.00	116.50	364.83	385.70	397.35	3,017.27	163.46	117.56
Rolling and sprinkling	212.00	220.20	193.47	405.07	244.75	2,216.94	188.70	168.02
Cost of culverts, bridges, etc			299.38	249.06	638.57	631.87		
Depreciation or rental on equipment								
Cost of rip rap in place				203.45	94.91			
Total cost	$4,779.45	$3,153.51	$5,813.37	$8,142.54	$6,634.47	$46,642.49	$3,857.26	$1,874.35
COST PER SQUARE YARD OF PAVEMENT.								
Engineering and inspection								
Superintendence	$0.026	$0.033	$0.0151	$0.0267	$0.0149	$0.020		$0.004
Excavation	0.167	0.044	0.1365	0.1210	0.1072	0.069	$0.121	
Stone, f. o. b. siding	0.244	0.270	0.2240	0.2213	0.2270	0.199	0.186	0.098
Bonding material, f. o. b. siding						0.041	0.036	0.043
Unloading stone to storage or loading direct	0.021	0.020	0.1315	0.0279	0.0279	0.226	0.169	0.060
Hauling stone and bonding material	0.112	0.121		0.2004	0.1180			

* Convicts.

TABLE IX—Concluded.

	Belmont—East Woodland.	Belmont—West Woodland.	Carbondale—DeSoto.	Carbondale—Makanda.	Carbondale—Snyder Cemetery.	Washington—Chicago East (State Line).	Washington—West.	Washington—Indiana Street.
Hauling and placing stone drains			$0.0073	$0.0081	$0.0068			
Hauling and placing tile drains			0.0086	0.0061	0.0034			
Shaping and rolling subgrade shoulders and side roads	$0.049	$0.040	0.0450	0.0410	0.0353	$0.033	$0.022	$0.004
Spreading stone and screenings	0.021	0.021	0.0417	0.0366	0.0408	0.044	0.025	0.016
Rolling and sprinkling	0.030	0.042	0.0221	0.0375	0.0257	0.032	0.029	0.022
Cost of culverts, bridges, etc			0.0342	0.0237	0.0657	0.009		
Depreciation or rental on equipment								
Cost of rip rap in place				0.0193	0.0098			
Total cost per square yard	$0.670	$0.591	$0.6660	$0.7696	$0.6825	$0.673	$0.588	$0.247
Cost per sq. yd. excluding excavation bridges, culverts and rip rap	$0.503	$0.547	$0.4953	$0.6056	$0.4998	$0.595	$0.467	$0.247

TABLE X—COST OF CONCRETE ROADS CONSTRUCTED DURING 1914 UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

	Batavia—Moosecheart.	LaSalle—Marquette Hill.	Petty—Millerville.	Mt. Vernon—Mt. Vernon.
Amount of pavement laid, square yards	2,942	4,748	8,661	1,504
Width of pavement, feet	18	18	10	10
Thickness of pavement, inches	8–6	10½–8½		7–6
Amount of cement used per square yard pavement	.36		.30	.344
Cost of cement per barrel f. o. b. siding	$1.12	$0.70	$1.68	$0.96½
Cost of sand per cubic yard f. o. b. siding	$1.20	$1.15	$1.40	$1.20
Cost of stone per cubic yard f. o. b. siding	$1.20	$1.10	$1.45	$1.47½
Average haul (miles)	¼	1½	1	¾
Rate of pay per hour, teams	$0.70	$0.62½	$0.37½	$0.35
Rate of pay per hour, labor	0.35 0.55	0.35 0.40	0.17½ 0.20 0.32½	0.15 0.20

COST OF LABOR AND MATERIALS.				
Engineering and inspection				
Superinttendence	$ 225.00	$ 300.00	$ 350.00	$150.00
Excavation	354.80	6,410.89	1,497.00	192.90
Sand and stone, f. o. b. siding	1,154.40	1,680.45	4,159.25	539.90
Cement f. o. b. siding	1,193.92	1,502.90	3,420.59	498.91
Expansion joints f. o. b. siding	109.68			
Unloading to storage or loading sand and stone direct	100.00		155.00	
Hauling stone and sand	225.70	1,342.39	840.00	138.90
Hauling cement		264.55	310.00	50.45
Incidental hauling		123.42	50.00	18.00
Hauling and placing gravel shoulders, including cost of material			1,399.94	
Shaping and rolling subgrade shoulders and side roads		723.20	282.00	89.01
Mixing and placing concrete, including cost of forms, etc	497.00	1,299.66	1,595.47	195.12
Covering, seasoning and cleaning concrete	80.00	230.20	70.00	26.16
Watchman and miscellaneous labor	50.00			
Cost of culverts and bridges, etc		753.77	835.00	
Freight on equipment	85.00	131.13	80.00	69.77
Depreciation or rental on equipment				
Total cost	$4,075.50	$14,762.56	$15,044.25	$1,969.12
COST PER SQUARE YARD OF PAVEMENT.				
Engineering and inspection				
Superintendence	$0.077	$0.063	$0.0404	$0.0998
Excavation	0.120	1.350	0.1730	0.1283
Sand and stone f. o. b. siding	0.392	0.354	0.4800	0.3589
Cement f. o. b. siding	0.406	0.316	0.3950	0.3310
Expansion joints f. o. b. siding	0.037			
Unloading to storage or loading sand and stone direct	0.034		0.0971	
Hauling stone and sand	0.077	0.282		0.0922
Hauling cement		0.056	0.0359	0.0335
Incidental hauling		0.026	0.0059	0.0120
Hauling and placing gravel shoulders including cost of material			0.1618	
Shaping and rolling subgrade, shoulders and side roads		0.152	0.0328	0.0593
Mixing and placing concrete, including cost of forms, etc	0.169	0.274	0.1840	0.1299
Covering, seasoning and cleaning concrete	0.027	0.048	0.0080	0.0178
Watchman and miscellaneous labor	0.017			
Cost of culverts and bridges, etc		0.159	0.0968	
Freight on equipment	0.029	0.028	0.0093	0.0463
Depreciation or rental on equipment				
Total cost per square yard	$1.385	$3.108	$1.7200	$1.3089
Cost per square yard excluding excavation culverts and bridges and gravel shoulders	$1.265	$1.599	$1.2884	$1.1807

TABLE XI—COST OF BITUMINOUS ROAD CONSTRUCTION DURING 1914 UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

	Carbondale—Murphysboro.	Jerseyville—Fieldon.	Sullivan—Masonic Home.	Nashua—Daysville.	Oregon—Daysville.	Oregon City—Washington Street.	Woodside—South Sixth Street.	Stites—Tri-City.
Amount of pavement laid, sq. yds	12,986	2,535	10,560	13,222	17,684	2,492	8,400	5,420
Amount treated with bituminous material	2,800	.....	2,000	13,222	17,684	2,492	8,400	5,420
Width of pavement, ft	12	‡	12	16 & 18	18	30	18	16
Thickness, inches	10	.....	‡	3–12	3–6	3–8	10	2
Number gallons bitumen used	5,600	.....	1,200	29,000	35,000	5,375	2,400	8,250
Average haul, miles	2½	1½	2½	2½	1½	1½	½	½
Rate of pay per hour, teams	$0.40	$0.40	$0.40	$0.50	$0.50	$0.50	$0.50	$0.40
Rate of pay per hour, men	$0.20	$0.20	$0.20	$0.25	$0.25 $0.30 $0.40	$0.25 $0.30 $0.40	$0.19½	$0.20
COST OF LABOR AND MATERIALS.								
Engineering and inspection	.....	.....	.....	$ 13.00	.....	.....	.....	.....
Superintendence	$ 271.42	$115.00	$117.80	300.00	$ 300.00	$ 70.00	$112.50	$130.00
Excavation	1,693.15	.....	.....	255.07	240.00	9.25	.....	.....
Stone f. o. b. siding (or at quarry)	2,580.60	142.62	597.90	*5,314.22	*1,540.00	*136.25	810.56	235.90
Binder f. o. b. siding	447.75	200.00	130.00	2,439.61	2,975.00	456.87	378.33	637.33
Scarifying	.....	.....	121.25	.....	.....	.....	.....	25.70
Gravel or sand f. o. b. siding	.....	.....	33.19	604.85	557.45	146.90	317.11	177.52
Unloading stone to storage or loading direct	2,117.20	132.30	251.80	.....	1,870.00	.....	430.75	25.18
Hauling stone, gravel and sand								233.10
Incidental hauling	.....	.....	.....	.....	127.50	.....	.....	53.95
Shaping and rolling subgrade, shoulders and side roads	637.77	.....	130.80	.....	178.33	.....	.....	.....
Spreading stone and screenings	654.22	†	236.94	150.00	†	†	533.72	107.30
Heating and applying bituminous binder including hauling	167.98	44.60	115.00	840.49	645.88	82.92	.....	163.76
Rolling and sprinkling	467.87	120.00	230.07	120.00	120.00	46.00	154.90	27.67
Bridges and culverts	974.89	.....	109.00	2,174.88	35.30	.....	.....	.....
Sweeping and cleaning road	.....	48.60	.....	.....	.....	.....	.....	.....
Hauling and placing stone drains	196.34	.....	.....	.....	.....	.....	.....	.....
Depreciation or rental on equipment	.....	.....	$60.00	$74.96	.....	.....	.....	$42.50
Total cost	$10,209.19	$803.12	$2,133.75	$12,287.08	$8,589.46	$948.19	$2,737.87	$1,859.91
COST PER SQUARE YARD OF PAVEMENT.								
Engineering and inspection	.....	.....	.....	$0.0009	.....	.....	.....	.....
Superintendence	$0.0209	$0.0454	$0.0112	0.0227	$0.0168	$0.0297	$0.0134	$0.024
Excavation	0.1305	.....	.....	0.0193	0.0136	0.0037	.....	.....
Stone f. o. b. siding or at quarry	0.1990	0.0563	0.5665	0.4020	0.0874	0.0548	0.0968	0.043
Binder f. o. b. siding	0.0345	0.0790	0.0123	0.1845	0.1680	0.1830	0.0450	0.117
Scarifying	.....	.....	.....	.....	.....	.....	.....	0.005

Gravel or sand f. o. b. siding			0.0031	0.0458	0.0315	0.0547	0.0378	0.032
Unloading stone to storage or loading direct	0.1620	0.0524	0.0238		0.1060		0.0514	0.005
Hauling stone, gravel or sand								0.041
Incidental hauling					0.0072			0.009
Shaping and rolling subgrade shoulders and side roads	0.0491		0.0124		0.0101			
Spreading stone and screenings	0.0504		0.0225	0.0113			0.0634	0.019
Heating and applying bituminous binder	0.0128	0.0176	0.0100	0.0636	0.0365	0.0590		0.030
Rolling and sprinkling	0.0359	0.0473	0.0220	0.0090	0.0068	0.0333	0.0184	0.005
Bridges and culverts	0.0750		0.0103	0.1645	0.0020			
Sweeping and cleaning road		0.0192						
Hauling and placing stone drains	0.0151							
Depreciation or rental on equipment			0.0057	0.0056				0.007
Total cost per sq. yd	$0.7852	$0.3172	$0.1007	$0.9292	$0.4859	$0.4182	$0.3260	$0.337
Cost per sq. yd. excluding excavation, bridges and culverts	$0.5797	$0.3172	$0.1804	$0.7454	$0.4703	$0.4145	$0.3260	$0.337

* F. o. b. at quarry.
† See hauling.
‡ Repairs.
§ Freight.

TABLE XII—ITEMIZED COST OF WATERBOUND MACADAM ROAD CONSTRUCTED IN 1915 UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

Items.	Reading Township, Livingston County (convict labor).	Reading Township, Livingston County (contract work).	Sand Ridge, Jackson County.	Seven Hickory, Coles County.
Total length of road	72,050	15,840	19,625	10,560
Width	9	9	10	9
Square yards	72,050	15,840	21,805	10,560
Thickness of metal	10 in. loose	10 in.	10 in. loose	10 in.
Average length of haul, miles	2.2	1½	2¾	1¾
Rate of pay labor and teams	50c per day / T 44-4-9 per hr.	22-2-9 & 44-4-9	15 & 40	20 & 45
Date of starting and completion	Apr. 12, 1915—Jan. 1, 1916		May 1, 1915—Dec. 10, 1915	July 5, 1915—Oct. 28, 1915

COST OF LABOR AND MATERIAL.

	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.
Engineering and general supervision	*$1,420.25	$0.020						
Superintendence and inspection	615.83	.009			*$1,125.08	$0.0516	$ 476.72	$0.0451
Excavation	4,028.19	.056			898.59	.0412	434.98	.0412
Cost of stone or gravel / Cost of screenings or bonding gravel	19,045.91	.264			2,274.00	.1042	5,141.23	.4868
Hauling stone and screenings	14,430.75	.201			4,167.10	.1911	2,095.20	.1984
Incidental hauling							50.15	.0048
Spreading stone and screenings	806.56	.011			310.89	.0143	206.21	.0195
Rolling and sprinkling	2,709.96	.038			689.61	.0316	195.19	.0185
Depreciation on equipment					*			
Incidental expense	3,832.81	.053					351.15	.0333
Cost of culverts and bridges and end protections					861.53	.0395	689.08	.0653
Shaping and rolling subgrade and side roads	1,271.50	.018			1,064.17	.0488		
Freight on equipment					53.25	.0024	30.24	.0029
Total cost	$47,091.51	$0.650	$10,846.58	$0.685	$11,444.22	$0.5247	$9,670.15	$0.9158
Total cost excluding excavations, culverts, etc					$9,684.10	$0.4440	$8,546.09	$0.810

* Indicates paid for or furnished by the State Highway Department.

TABLE XIII—ITEMIZED COST OF CONCRETE ROADS CONSTRUCTED IN 1915 UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

	Petty Township, Lawrence County.	Aurora Township, Kane County.	Blairsville Township, Williamson County.	Canton Township, Fulton County.
Total length of road, feet	5,250	5,300	3,355	3,971
Width, feet	10	18	10	15
Square yards	5,833⅓	10,600	3,720	6,619
Average length of haul, miles	2.8	1½	.52	1½
Rate of pay for labor and teams, per hour	20c & 40c	30c & 60c	22½c & 40c	17½c & 40c
Date of starting and completing work	July 13—Sept. 25	Apr. 15—June 15	Oct. 1—Nov. 27	Oct. 1—Oct. 28

COST OF LABOR AND MATERIAL.

	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.
Engineering and general supervision / Superintendence and inspection	$ *255.00	$0.043	$ 370.00	$0.035	$ *234.44	$0.063	.....	.....
Excavation	1,257.45	.215	2,213.13	.208	841.58	.226	.....	.....
Cost of stone or gravel	1,352.80	.232	1,467.27	.137	737.69	.198	.....	.....
Cost of sand	320.00	.055	925.29	.087	436.18	.118	.....	.....
Cost of cement	2,278.27	.391	3,836.16	.362	1,393.20	.374	.....	.....
Hauling sand, stone and gravel	1,042.15	.179	1,518.93	.143	582.93	.157	.....	.....
Hauling cement	186.85	.032	333.60	.031	89.10	.024	.....	.....
Shaping and rolling subgrade and side roads	293.50	.050	719.10	.068	795.44	.214	.....	.....
Mixing and placing concrete, forms and joints	822.81	.141	2,209.61	.208	669.58	.180	.....	.....
Covering, seasoning and cleaning concrete	112.50	.019	160.00	.015	94.70	.025	.....	.....
Incidental expense and freight on machinery	209.00	.036	10.50	.001	193.88	.052	.....	.....
Cost of culverts and bridges	118.55	.020	183.30	.017	23.50	.006	.....	.....
Depreciation on equipment	.....	.....	420.00	.040	102.97	.028	.....	.....
Cost of brick including hauling	.....	.....	.....	.....	.....	.....	.....	.....
Laying and grouting brick and curb	.....	.....	.....	.....	.....	.....	.....	.....
Total cost	$8,248.88	$1.413	$14,366.89	$1.353	$6,195.19	$1.665	$8,336.25	$1.26
Cost, excluding excavation and bridges	$6,872.88	$1.180	$11,790.46	$1.110	$5,330.11	$1.433	.....	.....

*Indicates paid or furnished by the State Highway Department.

TABLE XIII—Concluded.

	Petty Township, Lawrence County.	Tuscola Township, Douglas County.	Tuscola Township, Douglas County.	East Eldorado, Saline County. (brick).
Total length of road, feet	5,345	5,225	5,185	3,100
Width, feet	10	16	16	10
Square yards	5,939	9,289	9,218	3,444.4
Average length of haul, miles	4	½	½	.36
Rate of pay for labor and teams, per hour	20c & 40c	20c & 45c	20c & 45c	20c & 40c
Dates of starting and completing work	.....	July 22—Sept. 1	June 15—July 22	July 10—Sept. 25

COST OF LABOR AND MATERIAL.

	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.
Engineering and general supervision	$ *345.00	$0.058	.....	.....	.....	.....	$ *246.22	$0.071
Superintendence and inspection								
Excavation	661.54	0.112	.....	.....	.....	.....	417.37	.121
Cost of stone or gravel	1,030.40	.174	.....	.....	.....	.....	542.03	.157
Cost of sand	566.00	.095	.....	.....	.....	.....	591.20	.172
Cost of cement	2,096.54	.353	.....	.....	.....	.....	808.38	.233
Hauling sand, stone and gravel	1,436.55	.242	.....	.....	.....	.....	326.93	.095
Hauling cement	301.25	.051	.....	.....	.....	.....	19.40	.006
Shaping and rolling subgrade and side roads	321.87	.054	.....	.....	.....	.....	422.26	.123
Mixing and placing concrete, forms and joints	735.93	.124	.....	.....	.....	.....	547.12	.159
Covering, seasoning and cleaning concrete	82.00	.014	.....	.....	.....	.....	.....	.....
Incidental expense and freight on machinery	320.88	.054	.....	.....	.....	.....	582.97	.169
Cost of culverts and bridges	340.00	.057	.....	.....	.....	.....	1,467.53	.425
Depreciation on equipment	.....	.....	.....	.....	.....	.....	.....	.....
Cost of brick including hauling	.....	.....	.....	.....	.....	.....	2,344.79	.681
Laying and grouting brick and curb	.....	.....	.....	.....	.....	.....	495.58	.144
Total cost	$8,237.96	$1.388	.....	.....	.....	.....	$8,806.78	$2.556
Cost excluding excavation and bridges	$7,236.42	$1.220	$11,065.04	$1.19	$11,145.75	$1.21	$6,921.88	$2.010

* Indicates paid or furnished by the State Highway Department.

TABLE XIV—ITEMIZED COST OF BITUMINOUS MACADAM ROADS CONSTRUCTED IN 1915, UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

Items.	S. I. N. U. Carbondale Jackson County.	Pontiac Township Livingston County.
Total length of road, feet	1,500	2,640
Width	Variable	16
Square yards	3,500	4,693
Thickness of pavement	Standard	4 in.
Average length of haul, miles	½	½
Rate of pay for labor	25c per hour	25c per hour
Rate of pay for teams	50c per hour	40c per hour
Date of starting work	Sept. 29	Apr. 27
Date of completing work	Nov. 25	June 14
Gallons of bituminous material used per square yard	2.54	1.7

COST OF LABOR AND MATERIALS.

	Total.	Per square yard.	Total.	Per square yard.
Engineering and general supervision				
Superintendence and inspection	$ *270.00	$0.077	$ 186.22	$0.040
Excavation	257.95	.074		
Cost of stone and gravel	1,508.41	.430	803.50	.171
Cost of sand and chips	296.80	.085		
Cost of bitumen	758.51	.217	1,097.66	.233
Hauling stone, gravel and chips	734.16	.210	396.70	.085
Spreading stone and screenings	203.05	.058	84.30	.018
Rolling and sprinkling	135.82	.039	11.20	.002
Heating and applying bitumen binder	210.07	.060	150.20	.032
Incidental expense	65.21	.019		
Cost of culverts and bridges				
Depreciation on equipment				
Shaping and rolling subgrade and side roads	149.17	.043	56.61	.012
Freight on equipment	27.00	.008	11.92	.003
Curb and gutter	1,279.55	.365		
Scarifying			64.75	.014
Total cost	$5,890.70	$1.685	$2,865.76	$0.610
Total cost excluding bridges, culverts, excavation and curb gutter	$4,353.20	$1.243	$2,865.76	$0.610

* Indicates paid or furnished by the State Highway Department.

TABLE XV—ITEMIZED COST OF REPAIRS ON MACADAM AND GRAVEL ROADS IN 1915, UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

Items.	South Sixth Street, Woodside Township, Sangamon County.	Hawthorne Place, Woodside Township, Sangamon County.	Blairsville Township, Williamson County.	Bridgeport Road, Bridgeport Township, Lawrence County.
Total length of road, feet	4,400		12,022	3,900
Width, feet		24 and 30		12
Square yards	8,800	18,450	16,029	5,200
Nature of repairs	Resurfaced with .319 cu. ft. stone per sq. yd. and ⅓ gallon bitumen per sq. yd.	Surfaced with Montezuma Crude.	Surfaced with Tarvia B, ½ gallon per sq. yd.	Scarified and rolled
Average haul, miles	½	½	1	½
Rate of pay for labor	22c per hr.	22c per hr.	22½c per hr.	20c per hr.
Rate of pay for teams	50c per hr.	50c per hr.	40c per hr.	40c per hr.
Date started		May 23		Apr. 16
Date completed		June 9		Apr. 26

COST OF LABOR AND MATERIAL.

	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.
Engineering and general supervision, Superintendence and inspection	$*74.16	$0.0084	$*67.96	$0.0037	$*104.22	$0.0065		
Sweeping and cleaning old road			100.01	.0054	8.40	.0005		
Scarifying and reshaping old road							$ 15.43	$0.003
Cost of new stone, gravel and sand	141.81	.0161	98.10	.0053	98.59	.0061	281.15	.054
Hauling new stone, gravel and sand			48.90	.0027	56.83	.0035	144.00	.028
Incidental hauling							6.75	.001
Rolling and sprinkling							30.36	.006
Cost of bituminous material	268.92	.0306	389.14	.0211	400.00	.0250		
Heating, hauling and applying bituminous material	259.24	.0294	235.34	.0128	93.35	.0058		
Spreading sand and screenings	35.28	.0040	61.28	.0033	23.85	.0015	94.00	.018
Depreciation on equipment*								
Freight on equipment	40.04	.0045			36.68	.0023		
Incidental expense					7.95	.0005		
Total cost	$819.45	$0.0930	$1,000.73	$0.0543	$829.87	$0.0517	$571.69	$0.110

* Indicates paid or furnished by the State Highway Department.

TABLE XV—Continued.

Items.	Mt. Carmel Road, Lawrence Township, Lawrence County.	State Road, Lawrence Township, Lawrence County.	Beecher Road, Washington Township, Will County.	River Road, Rockford Township, Winnebago County.
Total length of road, feet	7,920	5,280	50,160	10,997
Width, feet	9	9	10,12 and 20	.....
Square yards	7,920	5,280	59,708	21,994
Nature of repairs	Scarified and rolled.	Scarified and rolled	Scarified and rolled	Surfaced with Montezuma crude asphalt. 0.36 gals. per sq. yd.
Average haul, miles	3½	4	2	3½
Rate of pay for labor	22c per hr.	22c per hr.	20c per hr.	25c per hr.
Rate of pay for teams	.....	33.3c per hr.	50c per hr.	50c per hr.
Date started	Mar. 25	Apr. 8	Mar. 26	.....
Date completed	Apr. 7	Apr. 15	May 8	.....

COST OF LABOR AND MATERIAL.

	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.
Engineering and general supervision	.....	.....	.....	.....	.....	.....	$*158.40	$0.0072
Superintendence and inspection	.....	.....	.....	.....	.....	.....	.....	.....
Sweeping and cleaning old road	.....	.....	.....	.....	.....	.....	67.06	.0030
Scarifying and reshaping old road	$ 16.18	$0.0020	$ 8.72	$0.0016	.....	.....	.....	.....
Cost of new stone, gravel and sand	332.85	.0420	200.55	.0380	291.90	$0.0049	88.02	.0040
Hauling new stone, gravel and sand	18.00	.0023	21.00	.0040	271.80	.0045	194.50	.0089
Incidental hauling	.....	.....	.....	.....	.....	.....	.....	.....
Rolling and sprinkling	41.34	.0052	16.49	.0031	166.00	.0028	.....	.....
Cost of bituminous material	.....	.....	.....	.....	.....	.....	387.58	.0176
Heating, hauling and applying bituminous material	.....	.....	.....	.....	.....	.....	115.00	.0052
Spreading sand and screenings	17.50	.0022	17.50	.0033	107.80	.0018	93.37	.0042
Depreciation on equipment*	.....	.....	.....	.....	.....	.....	.....	.....
Freight on equipment	.....	.....	.....	.....	.....	.....	56.00	.0026
Incidental expense	.....	.....	.....	.....	.....	.....	49.90	.0023
Total cost	$425.87	$0.0537	$264.26	$0.0500	$837.50	$0.0140	$1,209.83	$0.0550

* Indicates paid or furnished by the State Highway Department.

TABLE XV—Concluded.

Items.	Auto Club Road, Rockford Township, Winnebago County.	Cairo Road, R. F. D. No. 7, Alexander County.	Bloomington Township, McLean County.	Robinson Township, Crawford County.	DeKalb, DeKalb County.
Total length of road, feet	16,764	8,200	14,000	52,800	26,400
Width, feet			12	10	10
Square yards	18,627	16,400	18,670	58,666	29,333
Nature of repairs	Surfaced with Tarvia B. 0.55 gallon per sq. yd.	Surfaced with Aztec liquid asphalt. ½ gallon per sq. yd.			
Average haul, miles	3½	½			
Rate of pay for labor	25c per hr.	15c per hr.	22c per hr.	20c per hr.	25c per hr.
Rate of pay for teams	50c per hr.	40c per hr.	44c per hr.	40c per hr.	50c per hr.
Date started			Oct. 15	Sept. 24	Apr. 19
Date completed			Oct. 25	Nov. 24	July 12

COST OF LABOR AND MATERIAL.

	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.
Engineering and general supervision / Superintendence and inspection	$*35.00	$0.0019	$*34.20	$0.0021						
Sweeping and cleaning old road	30.54	.0016	5.60	.0003						
Scarifying and reshaping old road										
Cost of new stone, gravel and sand	34.27	.0018	39.25	.0024						
Hauling new stone, gravel and sand	140.00	.0075								
Incidental hauling										
Rolling and sprinkling										
Cost of bituminous material	577.00	.0310	384.65	.0234						
Heating, hauling and applying bituminous material	145.43	.0078	51.85	.0032						
Spreading sand and screenings	88.00	.0047	51.55	.0032						
Depreciation on equipment*										
Freight on equipment			88.20	.0054						
Incidental expense	61.00	.0033								
Total cost	$1,111.24	$0.0596	$655.30	$0.0400	$225.00	$0.012	$4,590.69	$0.078	$6,938.93	$0.237

* Indicates paid or furnished by the State Highway Department.

TABLE XVI—ITEMIZED COST OF WATERBOUND MACADAM ROAD CONSTRUCTED IN 1916 UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT

	Shields Township, Lake County.	Rich Township, Cook County.	Somonauk Township, DeKalb County.
Total length of road, feet	12,144	3,960	10,560
Width, feet	18	14	
Square yards	24,288	6,160	13,200
Thickness of metal, inches	5		7
Average length of haul, miles			1½
Rate of pay, labor and teams, per hour	30c & 67c		
Date of starting and completion	June 20—Sept. 9		

COST OF LABOR AND MATERIALS.

	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.
Superintendence	$ *325.00	$0.013				
Excavation						
Cost of stone	3,528.80	.145				
Cost of screenings						
Hauling stone and screenings	3,715.33	.153				
Incidental hauling						
Spreading stone and screenings	509.85	.021				
Rolling and sprinkling	606.74	.025				
Depreciation on equipment						
Shaping and rolling subgrade and side roads	242.11	.010				
Freight on equipment						
Cost of bridges and culverts						
Incidental expense	15.00	.001				
Total	$8,942.83	$0.368	$2,902.62	$0.472	$10,000.00	$0.757

* Paid by State.

TABLE XVII—ITEMIZED COST OF CONCRETE ROADS CONSTRUCTED IN 1916 UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

	Aurora Township, Kane County.
Total length of road, feet	7,800
Width, feet	18
Square yards	15,600
Average length of haul, miles	½
Rate of pay for labor and teams, per hour	35c & 65c
Dates of starting and completing work	Apr. 1—Aug. 9

COST OF LABOR AND MATERIALS.

	Total.	Per square yard.
Superintendence*	$ 676.47	$0.043
Excavation	1,775.61	.114
Cost of stone	2,597.10	.166
Cost of sand	1,572.47	.101
Cost of cement	8,326.05	.534
Hauling sand and stone	2,799.47	.180
Hauling cement	773.47	.049
Shaping and rolling subgrade and side roads	2,183.31	.140
Mixing and placing concrete and forms	3,527.22	.226
Covering, seasoning and cleaning concrete	267.52	.017
Freight on machinery	.....	.....
Cost of culverts and bridges	722.25	.046
Depreciation on equipment	.....	.....
Tile drains	247.04	.016
Hydrated lime	167.40	.011
Incidentals	394.23	.025
Total	$26,029.60	$1.668
Cost excluding excavation and bridges	$23,531.74	$1.51

* Paid by State.

TABLE XVIII—ITEMIZED COST REPORT ON BITUMINOUS MACADAM ROAD UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT, 1916.

O'Fallon Road, Shiloh Valley Township, St. Clair County.

Conditions (excluding contractors' profit and overhead charges). Length, 1,300 feet, width, 16 feet square yards, 2,310. Thickness of stone, 8 inches, average length of haul, 2.5 miles.

Rate of pay, men, 20 and 25 cents per hour, teams 40 cents per hour.

Work began August 28, work completed September 23.

COST OF LABOR AND MATERIALS.

Items.	Total.	Per square yard.
Superintendence	*$ 164.70	$0.071
Excavation	19.20	.008
Stone f. o. b. siding and hauling	1,063.03	.461
Bituminous binder f. o. b. siding, 4,590 gallons at 6 cents	275.40	.119
Heating, hauling and applying bituminous binder	192.00	.083
Rolling	56.30	.024
Freight on equipment	.....	.....
Depreciation on equipment	.....	.....
Total	$1,770.63	$0.766

* Paid by State.

TABLE XIX—ITEMIZED COST OF REPAIRS ON MACADAM AND GRAVEL ROADS IN 1916 UNDER SUPERVISION OF STATE HIGHWAY DEPARTMENT.

	Hawthorne Place, Woodside Township, Sangamon County.	Reformatory Road, Pontiac Township, Livingston County.	Street in Donovan, Beaver Township, Iroquois County.	Donovan Road, Beaver Township, Iroquois County.	Cemetery Road, Pekin, Tazewell County.
Total length of road, feet		2,640	1,320	9,240	4,750
Width, feet	24 to 30		Average 23	11	15
Square yards	18,450	4,690	3,457	11,293	7,917
Nature of repairs	Surfaced with asphaltic oil, .34 gallon per square yard.	Surfaced with asphalt, .61 gallon per square yard.	Surfaced with Trinidad C, .45 gallon per square yard.	Spiked, reshaped, added new stone, finished and surfaced, .70 gallon Trinidad C per square yard.	Surfaced with Standard road oil No. 7, .39 gallon per square yard.
Average haul, miles	¾	½	¼	1	2
Rate of pay, labor, per hour	21.9c	25c	25c	25c	22.2c
Rate of pay, teams, per hour	56.3c	50c	40c	40c	55.5c
Date started	May 26		July 8	July 8	June 1
Date completed	June 3		Aug. 23	Aug. 23	June 5

COST OF LABOR AND MATERIALS.

	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.
Superintendence	*$ 35.00	$0.0019	*$ 33.36	$0.007	*$ 38.61	$0.0112	*$ 128.70	$0.0114	*$ 23.21	$0.00294
Sweeping and cleaning old road	47.05	.0026	5.00	.001	5.00	.0014			11.00	.00139
Scarifying and reshaping old road							64.12	.0057		
Cost of new stone, gravel and sand	142.87	.0077	48.15	.010	62.80	.0182	462.32	.0410	47.70	.00600
Hauling new stone, gravel and sand	68.30	.0037	23.85	.005	35.97	.0104	385.56	.0341	67.20	.00850
Incidental hauling										
Rolling and sprinkling							139.68	.0124		
Cost of bituminous material	380.84	.0206	408.00	.087	124.72	.0361	640.00	.0566	182.03	.02310
Heating, hauling and applying bituminous material	69.90	.0038	74.75	.016	18.50	.0053	108.07	.0091	105.13	.01330
Spreading sand and screenings	38.10	.0020	38.75	.008	12.10	.0035	97.00	.0085	26.10	.00330
Depreciation on equipment*										
Freight on equipment					12.00	.0034	20.00	.0018	65.48	.00820
Incidentals	23.95	.0013	10.00	.002	21.89	.0064	50.00	.0044		
Total cost	$806.01	$0.0436	$641.86	$0.136	$231.09	$0.0959	$2,090.45	$0.1850	$527.85	$0.06670

* Indicates paid by State.

TABLE XIX—Concluded.

	Pekin, Tazewell County.	Bailey Lane, Yellowhead Township, Kankakee County.	Chicago-Vincennes Road, Yellowhead Township, Kankakee County.	Reading, Township, Livingston County.	Rich Township, Cook County.
Total length of road, feet	12,000	3,300	5,330	7 miles	18 miles
Width, feet	8	12	10	9	
Square yards	10,670	4,400	5,922	36,960	126,720
Nature of repairs	Gravel road surface with Standard road oil No. 7, .33 gallon per sq. yd.	Scarified, new stone added, screened and rolled.	Scarified, some new stone added, screened and rolled.	Resurfaced	Repairs
Average haul, miles	1	½	½		
Rate of pay, labor, per hour	22.2c	30c	30c		
Rate of pay, teams, per hour	44.4c	50c	50c		
Date started	June 5	June 20	June 12		
Dated completed	June 15	June 10	June 19		

COST OF LABOR AND MATERIAL.

	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.	Total.	Per square yard.
Superintendence	*$ 22.75	$0.00213	*$ 42.00	$0.00955	*$ 28.00	$0.00473				
Sweeping and cleaning old road	5.00	.00047								
Scarifying and reshaping old road			62.67	.01422	41.90	.00707				
Cost of new stone, gravel and sand			412.92	.09380	77.52	.01310				
Hauling new stone, gravel and sand	10.96	.00101	164.40	.03730	66.60	.01125				
Incidental hauling			39.00	.00886						
Rolling and sprinkling			46.36	.01050	27.21	.00460				
Cost of bituminous material	208.03	.01950								
Heating, hauling and applying bituminous material	54.08	.00506								
Spreading sand and screenings	7.00	.00065	44.85	.01019	31.20	.00527				
Depreciation on equipment*										
Freight on equipment			40.13	.00913	10.90	.00484				
Incidentals	2.00	.00018			2.77	.00047				
Total cost	$309.82	$0.02900	$852.33	$0.19355	$286.10	$0.04833	$5,000.00	$0.135	$2,912.69	$0.023

* Indicates paid by State.

MACHINERY OWNED BY STATE HIGHWAY DEPARTMENT.

Since the organization of the State Highway Commission in 1906, the department has accumulated a considerable amount of road machinery. This consists mostly of road rollers, machines for spreading bituminous materials, hauling outfits and concrete mixers, together with all accessories such as plows, harrows, sprinkling wagons, pumps and similar equipment.

Prior to the passage of the State Aid Law, this machinery was used for the purpose of constructing experimental roads at various points throughout the State. These roads were paid for by the townships, the State furnishing an engineer to superintend the work and an experienced operator for the road equipment. The latter expenses were borne entirely by the State and the machinery was furnished free except for freight and operating expense.

Since the State Aid Law went into effect, the practice of loaning this machinery to townships has been continued under the same conditions as before. Many miles of road have been built, and much good has resulted. As long as the present policy is continued this machinery will be used for township road work under the supervision of the State Highway Department. It is expected, however, that as the work of maintenance on State aid roads increases, more and more of this machinery will be used in that manner until all of the machinery will be used for maintenance purposes only.

A prediction of the future would be that the various counties in the State will purchase road equipment, and perform the same function of loaning it to the townships as is now being performed by the State Highway Department. This is of course merely a conjecture, but the day seems to be approaching when the county will own a considerable amount of heavy road building machinery, while the townships will own merely the light machinery in common use.

The State machinery has been carefully operated and thoroughly overhauled at frequent intervals. Its present condition is an indication of what good results can be accomplished by careful usage and thorough repairs made at the proper time. The oldest road rollers which have been in service about ten years are still giving satisfaction.

Figure 20 shows the value of the road machinery owned by the department at the present time. The black area denotes the value, after depreciation, of all machinery purchased prior to any one year. The hatched area shows the amount of new equipment purchased during that year. The total area up to the top of the white portion shows the amount spent for machinery and repairs up to the end of that year.

An examination of this chart shows that most of the machinery was purchased from 1909 to 1912 inclusive. It may be seen that under the present policy very little machinery is being purchased, and that the value of the equipment owned by the department is decreasing. The State Highway Department now owns eleven 10-ton road rollers, one 30-horsepower tractor with four 7-ton dump wagon trailers, six complete oiling outfits, three large concrete mixers, two scarifiers, two street sweepers, and other incidental equipment, such as sprinkling wagons, pumps, pipe, wheel scrapers, tool boxes and incidental tools.

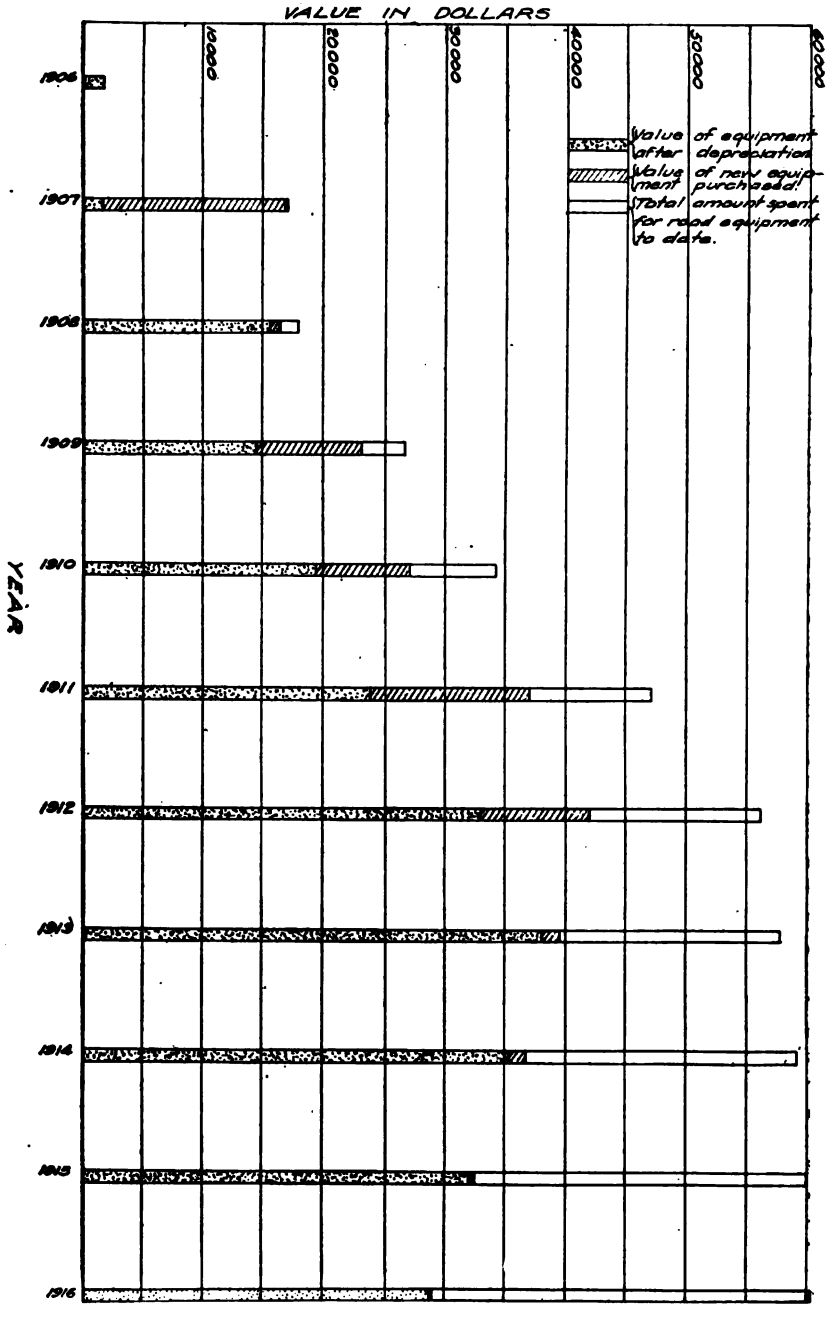


Fig. 20. Chart showing value of road machinery owned by State Highway Department.

EARTH ROADS.

A great many inquiries have been made concerning earth road construction and maintenance. It would hardly seem possible that such inquiries should be made on a subject with which we all are, or should be, more or less familiar. However, it is perhaps for this reason that so many are willing to offer their views concerning the construction and maintenance of earth roads. If the road builder would listen to all freely expressed views on such work, he would be working the road differently every day.

About 90 per cent of the roads in Illinois are earth roads and will likely remain earth roads for a great many years. The greatest problem, particularly in the case of the township or road district, is to construct and maintain properly the existing earth roads.

Fig. 21. Illinois mud.

While the construction and maintenance of earth roads are comparatively simple, yet because of this simplicity, the fundamentals of the work are often neglected. In view of the tremendous amount of earth road work that is to be done it is quite important that every effort be directed along lines that will accomplish the best results with the money expended, with the plan in mind that at any future time when further improvement of the road is demanded because of increased traffic, the preliminary work of grading and draining will not need to be repeated.

It must be held in mind that a large per cent of work done in constructing earth roads is permanent. If the grade is properly established,

the cross section properly designed, the drainage properly taken care of, etc., the work will not have to be done over or altered for future improvements. This being true, it can readily be seen that earth road construction is just as important as brick or concrete road construction and that just as much engineering skill is required to insure the best results.

A great many earth roads are constructed in a haphazard way and with very little regard for any future improvement. Such work is to be severely criticised as much of the time and money spent are practically wasted. Improperly worked earth roads result in a greater loss than the time and money that is put on them. Many roads are worse after working than before and the loss to the public in their use cannot

Fig. 22. Typical Illinois road when the frost is coming out of the ground.

be measured in a monetary sense. Improper construction often puts the earth road in such shape that a very large portion of the best soil is washed away by heavy rains resulting in a serious loss to the road.

The greatest fault encountered in the bulk of township road construction to-day, is that the road and bridge money is spread out over all the roads in the township each year and there are but very few roads that receive the amount of time and money needed to put them in first class condition. *The bulk of the road and bridge money is really spent in maintenance work on the existing earth roads, when a large per cent of such roads have never been properly constructed. This means an excessive maintenance charge.*

A majority of the townships have sufficient income to maintain the earth roads if they were once put into proper condition for effective maintenance. The most economical work that could be undertaken by a great many townships would be to finance some scheme that would permit all the earth roads in the township to be properly graded and drained and the necessary culverts and bridges constructed so as to be permanent. After the majority of roads were once put in first class condition, many of them could easily be maintained under good management by dragging and oiling, with the money that is available.

On earth roads which are properly constructed, the road drag and oil will materially improve them and permit them to serve the needs of a majority of the local traffic for a number of years. The improving

Fig. 23. An earth road suffering from poor drainage.

and maintaining of good earth roads in a community will serve all the taxpayers alike, and will be a means of getting their support in improving, with some hard surfacing material, some of the heaviest travelled or through connecting roads.

The main principles which make for efficiency in earth roads are proper drainage and maintenance. There is no material so easily affected by improper drainage as earth. When dry, it will readily support the heaviest concentrated loads of traffic, that will be imposed upon it. The same material, when thoroughly saturated with water, will not support even a light load. The secret, therefore, in constructing and maintaining such roads, is to utilize all possible methods for keeping them dry.

A prominent farmer in Illinois made the remark that if he just had a roof over his earth road from the farm to the market, he would not ask for anything better. This farmer knew what the earth roads needed, but his experience was limited as to how such results could be accomplished.

The skilled road builder can, with the most modern methods of construction and maintenance, drain earth roads by removing the underground seep water and treating the earth surface so that the road will be practically dry the greater part of the year and in such condition that it will serve moderate traffic economically.

The first step in the construction of an earth road is to have it surveyed and a permanent grade line and cross section established. The grade line should be established so that it will provide for the necessary drainage to the natural water courses. It should also provide

Fig. 24. Some bad grading practice which is current in Illinois. Avoid a mass of loose material in the center of the road.

for cutting down the hills and filling the hollows so that a permanent road bed will be made which will not have to be disturbed for further improvement. The cross section for the road will depend somewhat upon the drainage and whether it is a first, second or third class road. Special attention should be given to side ditches to insure that they will provide for all surface water and remove it rapidly. Many wide ditches on long steep grades should be paved with concrete, rip rap, or similar material to prevent serious erosion.

All culverts and bridges should be constructed of as permanent a material as can be conveniently secured. They should be of such size that they will readily provide for all surface water.

Drain tile should be laid at points which have underground seepage and on flat swampy roads when the water has no chance to flow readily in the side ditches. Drain tile should be used only when abso-

lutely necessary. The open side ditches properly constructed and maintained, will give better satisfaction where there is sufficient fall for the water to flow.

When a road is graded with a road grader pulled by either teams or a power tractor much good or harm may result according to the methods used. Many grave mistakes have been made in the past. It is a common occurrence to see a grading outfit engaged in the disastrous work of pulling sod, vegetation and muck from the side ditches to form a crown for the road. This is a direct violation of all the rules of engineering and common sense. The object strived for is a smooth dense surface which will resist water as much as possible. The loose vegetation absorbs water like a sponge, compacts poorly under traffic and is quickly converted into the worst form of dust or mud by the elements. Great care should be taken to avoid this mistake in grading.

Fig. 25. A poorly graded earth road. The crown is too steep for comfort or safety and the ridge of loose material in the center divides the traffic.

Another common defect in grading is to leave a ridge of loose material in the center of the road. This immediately causes traffic to split up into two lines as it is against human nature to bump along over clods of earth. The goal desired is that of a uniform distribution of traffic over the entire road surface and this ridge immediately precludes all possibility of such a condition.

The crown of the earth road should be no steeper than is required to shed the water to the ditches. If the crown is too steep traffic will automatically concentrate. As an average figure the crown should never be steeper than one inch per foot over the traveled portion of the highway.

The construction of earth roads should be guided by these fundamental principles of drainage, proper materials and proper grades together with the universal rules of common sense. Under such guidance good earth roads will result.

Earth roads can usually be constructed at a very low cost; however, they require constant maintenance, which on many very heavily traveled roads, becomes a rather heavy burden. The maintenance should *never* be neglected. A road, low in first cost, with high maintenance expense is often just as economical as a road of high first cost with practically no maintenance. The main purpose of a road is to satisfy the requirements of traffic. The earth road in some sections may do this as well as brick pavements in other sections. If this is kept in mind, more attention will be given to the earth roads and the money spent on them will not be thought of as lost.

After earth roads are once constructed, maintenance should begin. It is neglect that makes earth roads bad and causes two dollars to be spent where one would have done the work. On account of the necessity of giving earth roads constant attention it is important that every

Fig. 26. Note the results of leaving a ridge of loose material when grading an earth road.

township arrange for a patrol system of maintenance or some similar form, where someone can give his entire time to a section of roads and be held responsible for their condition.

Earth roads should be maintained by keeping a good crown on the road, keeping side ditches opened and the surface smooth so the water will readily drain to the side ditches and so traffic will be distributed over the entire surface. The distribution of traffic will keep the road uniformly compacted and free from ruts.

The systematic use of the road drag on a road that has been properly graded, will show better results, for the amount of money spent, than anything else that can be done to the road. It has been shown that systematic dragging can be done for a cost of from ten to fifteen dollars per year per mile of road, after the road has once been properly graded and the drainage adequately cared for.

RULES FOR ROAD DRAGGING.

Roads properly dragged will dry out weeks earlier in the spring than a road not so maintained, and when dried out will be smooth and in excellent condition. Moreover, they will not rut up so readily during the winter.

The ordinary country road can be well maintained if dragged at the proper time on an average of twice a month. The dragging will have to be more frequent during winter and spring than in the summer time.

CONSTRUCTION OF A ROAD DRAG.

The drag should be made light, not heavy. Therefore oak and other heavy hard woods are not so well adapted to this purpose as a softer wood. Figures 27, 28 and 29 illustrate different forms of drags which have proved successful in practice. A drag should be about 8 feet long.

WIDTH TO BE DRAGGED.

The law prescribes a width of not less than 14 feet shall be dragged. This will require at least two round trips with a drag 8 feet long.

CROWN.

If a road is flat or hollow in the center it would be better to crown or grade it up with a road machine until the center is about ten inches higher than the sides. The center should be about thirty inches above the bottom of the gutters or side ditches.

It is not absolutely necessary, especially on side roads, or lightly traveled roads, that the roadbed be crowned up by a grader to get good results. But where it is done, the best time to do it would be either early in the spring, so that the spring rains would have a chance to consolidate the road, or else early in the fall just preceding the fall rains. The spring, however, is a much better time. It should not be done in the middle of the summer or just preceding a dry spell, as the road would become very dusty and not compacted. The repeated use of the drag, if used right, will gradually crown a road, but it should be remembered it is not expected a drag will make a road. *It will only maintain it.*

WHEN TO DRAG.

Unless the road is in the right condition, the work of dragging will be wasted. One thing to be insisted upon is that the work be done at the right moment. The right time is when the road is wet. The muddier it is the better the results. On a road that is in extremely bad condition and the mud is very deep, it is probable that the form of drag shown here in Figure 29 known as the lap plank drag, can be worked to the best advantage.

In the summer time and early fall, dragging should be done while it is actually raining, for unless the rain is exceptionally heavy and

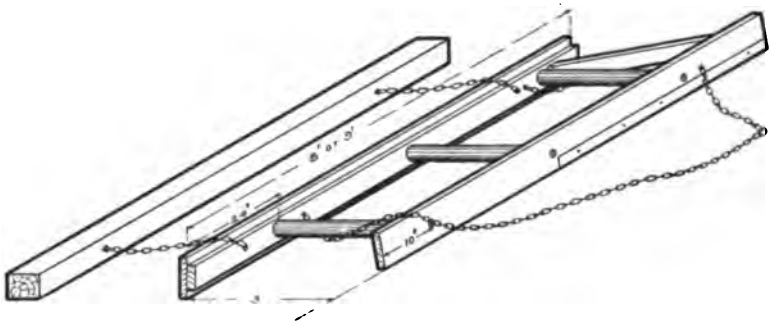


Fig. 27. Plank Drag. This drag is made from two pieces of ten or twelve-inch plank, two or three inches thick and eight or nine feet long, reinforced by a two by six-inch strip. The cross braces are four-inch sticks shaped to fit into a two-inch hole. A board platform, not shown in the cut, is laid on the cross pieces for the driver to stand upon. A trailing log may or may not be used. It serves to smooth the surface and distribute the mud that may pass by the drag.

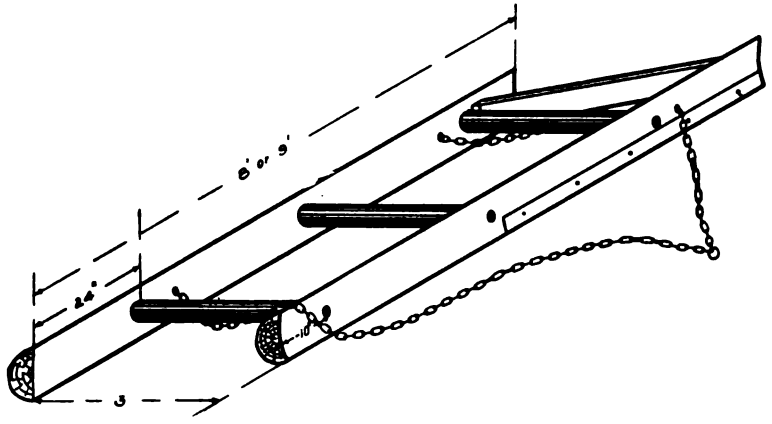


Fig. 28. Split Log Drag. This drag is made from a ten or twelve-inch log, eight or nine feet long. The cross braces are four-inch sticks shaped to fit into a two-inch hole. A board platform, not shown in the cut, is laid on the cross pieces for the driver to stand upon.

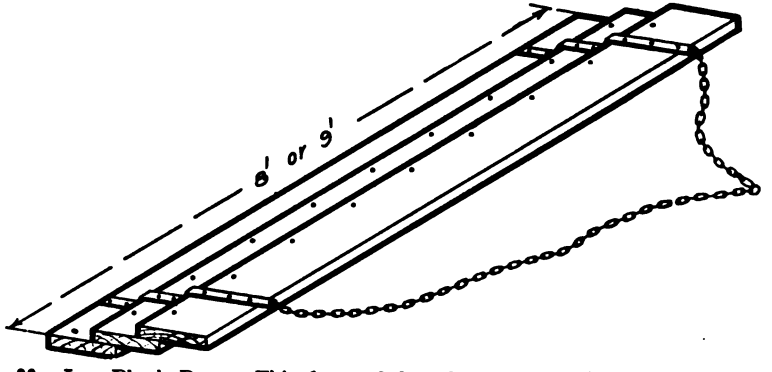


Fig. 29. Lap Plank Drag. This form of drag has proved effective for smoothing the surface.

long continued, the water will penetrate the dry roadbed so fast that the surface will be comparatively dry when the drag is used after the rain has stopped, with the result that the road surface will work up in crumbs. When this happens it is a sign the road is too dry. The nearer it is possible to spread the mud over the road as a mortar, much in the same way a mason works mortar with a trowel, the greater the improvement produced.

Under no conditions should a road be dragged when it is dry. This merely crumbles up the surface and makes a layer of the loose material which quickly becomes dust and is again turned into mud which will hold water on the surface of the road; and this is exactly the condition that is to be prevented. Drag when the road is good and muddy. Don't drag when it is dry. Drag whenever possible at all seasons of the year. If a road is dragged immediately before a cold spell, it will freeze in a smooth condition.

Fig. 30. An earth road with firm center and muddy side roads.

HOW TO USE A DRAG.

Make a light drag.
Drive the team at a walk.
Ride on the drag, don't walk.
Don't drag a dry road.
Drag when the road is muddy.
Drag, if possible, immediately before a freeze.
Begin at one side of the road, returning on the opposite side.
Always drag a little earth towards the center of the road until it is raised ten or twelve inches above the edge of the roadway.
Do not attempt to move very much material at one time with a drag.
If the drag cuts in too much shorten the hitch.
The amount of earth the drag will carry can be regulated by the driver, accordingly as he stands near the cutting end or away from it.

When the roads are first dragged after a very muddy spell, vehicles should drive, if possible, to one side until the road has had a chance to freeze or partially dry out. The exercise of a very little care on the part of the users of the road will do quite as much as the drag towards securing a smoother road.

There has been a great deal of discussion as to how a road should be leveled or dragged. Many claim that it can be done very efficiently and effectively with a tractor and large leveler, others claim that the light two-horse drag is more efficient. There is no question but that both have proved satisfactory in different places. The most economical scheme depends a great deal upon the local conditions. It is not so

Fig. 31. A well built and properly maintained earth road.

much the method as the results that count. The most essential points to be observed are to keep the surface of the road perfectly smooth, well crowned, and to keep the ditches clean.

USE OF ROAD OILS.

Another method in use for the maintenance of earth roads is the application of oil to the earth surface. It is to be borne in mind that the use of road oil is purely a maintenance proposition, and it should not be considered as a method of construction.

The oiling of earth roads has become very popular in the State during the past three years. In many instances, however, the people have had an exaggerated idea of the benefits to be realized. Often times oil has been used by people who were expecting to secure some

form of permanent road by that means. Many seemed to feel that the application of one-half gallon of road oil to the square yard of road surface would immediately make the earth road as satisfactory or as permanent as a hard road. The fallacy of such an assumption is evident. In road construction, as in any other work, the benefits received depend upon the money invested and to secure hard roads it is necessary to pay a hard road price. This popular misunderstanding of the purpose of road oils has lead to a great deal of disappointment in many communities, and has caused a great deal of condemnation of the officials responsible for its use. It should, therefore, be remembered in considering the use of road oils, that it is not a form of permanent construction.

As a maintenance proposition, however, it is believed that the benefits derived from the application of road oils are worth the money invested. The purpose of applying road oils is two-fold, first, to suppress dust, secondly, to make the earth surface more waterproof. These two features naturally combine to produce an earth road which is more pleasant for traffic during the dry months and which is less susceptible to the action of rain during the summer months and also a road which is much more serviceable throughout the year, and usable for longer periods than the ordinary earth roads.

The time to consider the use of oil is after the road has been properly prepared. In order to secure efficient and effective results, it is absolutely necessary that the earth road be properly graded, drained and dragged, before the oil is applied. If the oil is applied to a poorly drained road, or one whose surface is flat and improperly graded, even worse conditions may result than would occur if the oil were not used. When rain falls upon the undrained surface, it stays there. Traffic then comes upon the road and churns this mixture of oil, water and earth into a lob-lolly of greasy mud which is even more disagreeable than the natural mud formed by the combination of earth and water only.

When the oil is applied, the road surface should be dry and free from dust. If the oil is applied to a dusty surface, it will not penetrate the earth but simply lie on the surface, mingle with the powdery earth and produce a greasy dust which is very disagreeable. If the road surface is at all dusty it should be cleaned carefully by sweeping before the oil is applied. The use of oil on a road which is not properly prepared is an absolute detriment to the road besides a waste of money and materials. An excessive amount of moisture in the earth road at the time of application will produce poor results. A slight amount of moisture may be present without great detriment, but for the best results, the road should be dry.

For the first application of oil, about one-half gallon per square yard is commonly used. During succeeding treatments, in following years, this amount may be reduced to one-third or one-quarter of a gallon, depending upon conditions. It has been a common opinion that if one-half gallon to the square yard were good, one gallon would be better.

This is wrong. Only that oil which penetrates the surface will be beneficial to the road. If any is left exposed, it is disagreeable to traffic, is absolutely useless to the road and represents a needless expenditure..

The best time to apply road oil is during the dry months, between April and September. It should be borne in mind that the treatment of the road with oil should be repeated almost every year for practically an indefinite period, if the maximum benefit from the oil is to be derived.

When the oil is applied a uniform distribution of the material must be secured. In order to bring this about, it is customary when applying a one-half gallon treatment to make it in two applications of one-quarter gallon each. In this way much more uniformity will be gained.

Oil has been applied successfully by means of the ordinary gravity distributing wagon. However, much better results can be secured if some sort of pressure distributor is used. There are a great number of these pressure distributors on the market, varying in cost from $400 for the horse drawn vehicles to $6,000 for the highest type of motor truck distributors. The cheaper varieties however are very successful in their operation, and are perfectly adapted to the use of the average country road builder. The purchase of the higher priced truck distributors is justified only when a great amount of oiling is to be done.

Road oil is usually shipped in tank cars of 8,000 or 10,000 gallon capacity. Some oil companies are able to furnish smaller cars of 4,000 to 6,000 gallon capacity, but such cars are few and are usually hard to obtain.

If the oil used is a heavy one and requires heating a supply of steam may be connected to the heating coils which are inside the tank. The source of steam is readily obtained, either from some convenient power plant or by use of a traction engine. This manner of heating oil is very simple and effective in its operation.

In order to remove the oil from these tank cars, some form of pump may be used. The rotary pump is the one most in vogue at the present time, although the common form of hand pump will work satisfactorily, if the oil is pumped cold. The ordinary suction pump cannot be used for hot oil as it will soon burn out the valves.

In many cases the amount of work to be undertaken is too small to justify the purchase of a tank car of oil. In such cases, it may be obtained in barrels, holding ordinarily about 50 gallons each. The cost of oil when shipped in barrels is about 2 or 3 cents a gallon more than when shipped in tank cars.

It is often times desirable to heat oil in the distributing wagon or in an auxiliary heating kettle. In such case, great care should be taken not to overheat the oil. A thermometer should be used so that an exact measurement of the temperature may be made. If care is taken not to heat the material beyond this point which is based for the grade of oil in question, injury to the material may be prevented and the possibility of serious accident removed. In most communities, however, where the common grades of road oils are used, it is customary to use oil which may be applied cold. This will of course eliminate a great deal of the difficulty and bother of heating.

It is customary to oil a strip about fifteen feet wide on the average country highway. After the oil has been applied, a coarse torpedo sand should be applied to the surface, using about one cubic yard of sand for every one hundred square yards of surface to be covered. This procedure, although an additional expense, is a good investment. The sand unites with the oil and the earth and produces a surface which is more stable under traffic than the oil and earth surface alone. In some cases where sand cannot be obtained readily, its use may be omitted, but in all cases where sand is available at any reasonable cost, it should be used.

A great deal of misunderstanding has prevailed concerning the cost of applying road oil. When stating the cost of road oiling, the cost of grading, draining and dragging the road surface preparatory to oiling should be considered separately. These items may vary in cost from $100 to $2,000 per mile, depending upon conditions. The cost of oiling, on the other hand, will remain practically constant for any given condition. The cost of cleaning the surface of the road varies from $25 to $50 per mile; the cost of applying the oil varies from $50 to $150 per mile, of 15 foot width. The cost of the oil will be the only item which varies to any great extent. If one-half gallon of oil per square yard is applied for a mile to a width of 15 feet, 4,400 gallons of oil will be required per mile. If the cheaper paraffin base oils are used, costing on an average of 4½ cents a gallon, the cost of oil alone will be about $200 per mile. If on the other hand the higher grade asphaltic oils are used; costing about 2 cents a gallon more than the paraffin oils, the cost of oil will be about $290 per mile. It will then be seen that the average cost of oiling per mile will be, figured on this basis, about $300 using the paraffin oils, and about $400 with the asphaltic oils, using one-half gallon treatment. In case one-third or one-quarter gallon treatment is used, the cost per mile may be reduced correspondingly. Experience seems to indicate that considering the amount of oil required for an indefinite number of treatments, the average cost per year for oiling earth roads will be about $250.

The quality of the oil used is of utmost importance. A great many of the failures which have occurred in the past have been due to the use of an oil which was not suited to the work at hand. It is absolutely essential that all oil for use on earth roads be purchased under carefully drawn specifications, and that each consignment of oil be tested by a competent testing engineer, to insure that the specifications are fulfilled.

Up to the present time, the paraffin base oils have been used for road work almost exclusively in Illinois. In many cases very satisfactory results have been obtained. However, experience points to the fact that the use of the higher grade asphaltic oils will produce very much better results at a slight increase in cost. The paraffin oils are used largely as dust layers. When these have been applied to a dusty surface, a greasy dust not at all pleasant, has been formed. This dust readily turns into a greasy mud during rainy seasons. The residue contained in the paraffin oils has little binding quality and therefore does not add any stability to an earth surface. The asphaltic oil, on the other hand, in addition to being an effective dust layer, contains a residue which has very

great binding qualities, and this naturally produces much more satisfactory results in earth road work.

Whatever oil is used should be of a very thin or light quality, in order that it may readily penetrate the earth road surface. The object in applying the oil is to secure the proper penetration, as only in that manner can the oil be united with the earth to produce the desired results. If too heavy an oil is used it will lie on the surface, with very unsatisfactory results, both as to the suitability of the road for travel and added expense for the wasted oil.

There is a very common misunderstanding on the part of the public as to the meaning of the term "per cent asphalt" used in connection with oil for road purposes. Road oil should never be purchased on the basis of "per cent asphalt" as commonly used in the commercial world. There are so many different things entering into the determination of the suit-

Fig. 32. Oiled earth road. Six months after oiling.

ability of oils for road purposes, that the only safe way is to purchase the same under carefully drawn specifications and subject to tests by a competent testing engineer.

The use of road oil has been widely condemned in certain communities because the results obtained were not satisfactory. In many instances this criticism is unmerited because of the fact that the roads were not properly graded before the oil was applied, and because the proper grade of oil was not used for the work. It is not fair to judge any type of improvement by a sample of work which was not properly carried out.

It is evident that the whole earth road problem, after the original construction has been properly executed, resolves itself into that of maintenance. The most effective methods of maintenance are the use of the road drag, and the use of road oil; each method will help the other.

An oiled road should be dragged at intervals, in order to keep the surface smooth. Oil will help a well dragged road, by eliminating the dust nuisance and making it more waterproof.

In many instances if the money spent on oil were used in dragging, almost as good results would be obtained. On the other hand there are many places where the elimination of the dust nuisance is of great enough importance to justify the expenditure of money for road oils. The determination of the economic value of road oil, must be made from a study of local conditions. In many places it may be a justifiable expense; in others it may not.

There has been a great deal of lethargy on the part of the public, during the past, in regard to earth road improvement. The possibilities of the earth road have not been realized. Although much talking has been done concerning the necessity of grading and dragging earth roads, there has been no popular response. The advent of road oiling, on the contrary, was at once hailed as the solution of the earth road problem, and was accorded all the advantages of popular approval. As a result, much grading and dragging has been done which otherwise would have been neglected. The public has come to feel that there are better things in store for the earth road than impassability the greater portion of the year. There is very much adverse criticism, and on the other hand, very much praise for the oiled earth road. Many claim that it has not been worth the money which has been expended upon it. In any event, the public owes the oiled road movement a debt of gratitude because the people have been awakened to the necessity of grading and dragging the earth road, and to a realization of the fact that the earth road can be improved.

USE OF CONVICT LABOR ON THE PUBLIC HIGHWAYS.

In 1913 the State Legislature passed an act entitled, "An Act to authorize the employment of convicts and prisoners in the penal and reformatory institutions of the State of Illinois in the preparation of road building materials and in working on the public roads."

SECTION 1. *Be it enacted by the People of the State of Illinois represented in the General Assembly*, That the commissioners of the Northern Illinois Penitentiary, commissioners of the Southern Illinois Penitentiary and the board of managers of the Pontiac Reformatory of the State of Illinois are hereby authorized and empowered to employ convicts and prisoners in the penal and reformatory institutions of this State, who are sentenced for terms of not more than five years, or who have not more than five years to serve to complete their sentence, in working on the public roads or in crushing stone or preparing other road building materials at points outside the walls of the penal or reformatory institutions. Upon the written request of the commissioners of highways of any township in counties under township organization or counties not under township organization, said penitentiary commissioners, and board of managers of the Pontiac Reformatory shall detail such convicts or prisoners as in its judgment shall seem proper not exceeding the number specified in said written request, for employment on the public roads or in the preparation of road building materials, in the township, road district or county requesting the same on such terms and conditions as may be prescribed by the said penitentiary commissioners or the board of managers of the Pontiac Reformatory.

SEC. 2. The commissioners of highways or boards of county commissioners, as the case may be, shall pay all additional expenses for guarding such convicts while working on the public roads or in the preparation of road building materials outside the walls of the penal or reformatory institutions, in their respective townships, road districts or counties.

Approved June 28, 1913.

APPLICATIONS FOR CONVICT LABOR.

The following form of application is used in connection with convict labor work and its contents show the general steps necessary to secure the services of convicts for public road construction.

STATE OF ILLINOIS.
STATE HIGHWAY DEPARTMENT.

PETITION FOR CONVICT LABOR.

.....Illinois, ...19....

We, the undersigned members of the board of highway commissioners of .....Township, ...County, having provided the necessary funds, which will amount to about ..... dollars, ($.....) hereby petition the board of commissioners of the .....Penitentiary, to furnish .....convicts for the purpose of constructing about .....miles of ..... road in accordance with the laws of Illinois, regarding the use of convicts, approved June 28, 1913.

The essential requirements of the law and of the authorities governing the convicts are as follows:

"The commissioners of highways or the boards of county commissioners as the case may be, shall pay all expense for guarding the convicts while working upon the public highway or in the preparation of road building material.

"The expense of transporting the convicts and necessary prison guards to and from the penitentiary; the freight on all equipment and incidentals necessary for housing and caring for the convicts shall be paid by the local authorities, also the salary of one or two guards who will receive about $75 each per month and a horse and buggy or an equally convenient means of transportation for the guards. In addition the commissioner or board of county commissioners shall pay the sustenance of all convicts, which has been estimated and fixed at $0.50 per convict, per day, counting continuous time from the day the convicts leave the penitentiary until they are returned.

"It is expected that the convicts will camp in tents near the proposed improvements, but it is desired that the road officials will furnish proper means of transportation for the men to and from the work, especially when the distance exceeds one mile. A good camping ground with adequate water supply shall be provided by the road officials.

"It is understood that all convicts excepting those required for cooking and other work about the camp, will work at least eight hours per day, weather conditions permitting, excepting Saturday afternoons and all legal holidays. The eight hours shall be exclusive of all time required for noonday lunch and all time required for transportation to and from work.

"It is understood that the convicts will be permitted to work in sections or groups and under a foreman designated by the road officials. However, the officials of the penitentiary are to have complete jurisdiction over the care of the convicts.

"Should any convict refuse to work, or become disrespectful to the men in charge, he shall be returned to the prison.

"It is expected that groups of 25 or 50 convicts each, will be requested, and that they will be used in heavy grading work or in constructing at least five miles of hard road.

"Upon proper request of the road officials to the State Highway Department, it may issue requisition on the penitentiary for the necessary crushed stone, and it may also furnish engineers for making the necessary surveys and supervising the construction and also furnish the proper machinery for building hard roads."

Subscribed by us this ..... day of ....., 191..

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Attested: *Commissioners of Highways.*

.....

Clerk.

.....

.....

P. O. Address.

.....

County Supt. of Highways.

.....

P. O. Address.

Since the passage of this act seven convict camps have been established in different communities for the purpose of constructing roads. Experience up to the present date shows that these camps have been a pronounced success from both the economic and humanitarian standpoint. The convicts have shown themselves to be efficient and intelligent workers. In many cases men of exceptional ability have been developed. The conditions of camp life have proved ideal. Much greater freedom of action is enjoyed by the convicts in camp than within the prison confines. The fact that the men are on their honor naturally results in an improvement. This, combined with pleasant out of door employment, is conducive to much better conditions among the men, and results in an ideal form of legal confinement.

The economy of a convict camp depends upon the size of the job of road work. It is evident that the expense of transporting the convicts to and from the penitentiary and establishing a suitable camp is usually very small when distributed over the cost of a large job. On the other hand, in the case of a small job, it is often true that the expense of establishing a camp will make the cost of convict labor more than free labor. In such cases the use of convicts can be justified only on account of its beneficial effect upon the men.

If a large piece of construction is to be undertaken, there are a great many advantages which may be derived from the use of convicts. This is especially true in localities where free labor is scarce. If convicts are used, the inconvenience and delays caused by shortage of help, strikes and the changing of the personnel of the force are avoided. The efficiency of any construction depends upon an efficient organization of the work. If a fixed number of men can be depended upon, a good organization can be worked out. The consensus of opinion among construction superintendents is that the maximum efficiency may be secured from a laborer if he is kept upon the same class of work as much as possible. A convict camp permits this idea to be put in force while the constant hiring and discharging of men when free labor is employed often times makes this impossible.

Another advantage in using convict camps, when there is a fixed number of men available at all times, is that the force may be worked at many times when, under the other system, nothing could be done. There are many half days or parts of days when weather conditions would permit work if the men are on the ground and accessible. If on the other hand, it is necessary to scout around over the country to collect a gang for such a short period, the scouting will not be done, and the construction will be stopped. As a result a job built by convict labor may often be completed earlier than if free men were employed.

Although it is true that convicts must be paid for on the straight time basis regardless of holidays and rainy weather, yet such is the case for a large per cent of free labor if one wishes to keep the same gang of men. The results therefore are in many cases in favor of convict labor on this basis alone. Cost records show that it costs much less per day to keep a convict than it does to pay the wages of free labor. There are many other advantages of a similar nature from the view point of material economy but these advantages are insignificant when compared with the benefits derived by the public from giving a more healthful life to the convict and from creating a higher ideal of legal confinement.

Many inquiries have arisen concerning the desirability of having a convict camp in a community. The term "convict" has become associated in the public mind with disorder, crime and depravity, and naturally there is a lurking suspicion and fear which manifests itself by these inquiries. It is very gratifying to be able to state that no objections can be raised to convict camps based upon their conduct up to the present date. Investigations in communities where convict camps have been used show that the deportment has been of such a nature that a very good impression has been left. In fact these camps have left a more favorable sentiment in the community than the usual construction camps.

It should be understood that the men sent out to the convict camps are "trusties" who are strictly on their honor. Each man fully understands that if he becomes unruly or is guilty of objectionable conduct, he will be returned to the penitentiary. The privilege of the camp life is so thoroughly appreciated by the men that they make every effort to keep order both as individuals and as a body.

It is usually impossible to tell a convict laborer from any other as they are all dressed in citizen's clothes and work unguarded individually or in gangs wherever work is to be done. The only guard on the job is a custodian who looks after the general welfare of the men during the day. There is usually a watchman on duty in camp at night.

Out of a camp of fifty convicts about forty will be available for actual road work. The other ten men will be kept busy in the dining room, tailoring department and with other routine camp duties. The camp and everything connected therewith are kept clean and sanitary with the result that no objections can be raised against general camp conditions.

These camps have been open to inspection by the general public and all interested parties have been urged to investigate the conditions.

When any townships or counties have made inquiry concerning the proposition of establishing a convict camp for road construction, this

department has made a special effort to make an inspection of the work and a report upon the advisability of the proposed camp.

Since the passage of the law permitting the use of convicts on the public highways seven camps have been established which were located at the following points: Dixon, Deer Park, Mokena, Reading, Beecher, Fort Gage and Ava. The Chester penitentiary furnished convicts for the two last mentioned while the Joliet penitentiary furnished the men for the remainder. Of these the camps at Beecher, Reading, Fort Gage and Ava were on road construction supervised by the State Highway Department. As a rule each camp has consisted of about fifty men.

The following is a brief description of the road construction in Reading Township, Livingston County, together with an explanation of the convict camp established for carrying on this work. It is believed that this camp was typical of all such camps and description will be confined to this one only.

Reading Township, Livingston County, is a rich agricultural township, lying just south of Streator, Illinois. There are but two small villages in the township, which together have a total population of about 400. The township, which is six miles square, has an assessed valuation of $1,275,000.

For a number of years many arguments had been presented to the taxpayers in favor of hard roads. The township officials and a number of interested farmers became enthusiastic for better roads and proceeded to draw up a petition to vote bonds in the township to the extent of $63,500 ($1 on each $100 assessed valuation for five years) for constructing some 15 or 20 miles of crushed stone roads nine feet wide. The proposition was presented to the taxpayers at the April election in 1915 and it carried by a large majority.

After the bond issue had carried, the commissioners communicated with the State Highway Commission for assistance. The State Highway Commission agreed to furnish them with an engineer to superintend the construction, three macadam road outfits and the necessary crushed stone from the penitentiary, providing convict labor could be used in constructing the road.

A very careful study of the system of proposed roads in the township was made. It seemed entirely practicable to construct a majority of the roads during one season, and to handle all the work from one central point, where a convict camp might be established.

Surveys were ordered and all detailed arrangements made for starting the work within 30 days after the bonds were voted.

On April 7, a superintendent from the State Highway Department, was placed in direct charge of all the improvement.

On May 13, forty-six convicts were sent out to Reading and a camp was established.

During the months of April and May there was very little work done on account of delays in disposing of bonds and on account of the general condition of the weather. However, by the first of June, all preliminary arrangements had been made and actual construction started.

The superintendent from the State Highway Department was in direct charge of all work. He was supplied with a small auto truck used for shifting men to and from different points on the job. The car also enabled him to keep in close touch with all divisions of work, namely, the unloading plant, the hauling system, the excavation, subgrade work, the spreading and the finishing. The work was scattered over some 20 miles of road and even with the car, it kept the superintendent very busy.

EQUIPMENT.

To build the number of miles desired in one season and in the most economical manner with convict labor, it was decided that all the crushed stone should be hauled with an industrial railroad outfit. The commissioners accordingly arranged to rent a complete outfit, which consists of one 30-horsepower locomotive, 65 one and one-half yard dump cars, five and one-half miles of 24-inch gauge, 20-pound steel rail, and accessories

Fig. 33. Material yards and unloading plant.

from the Orenstein Arthur Koppel Company of Chicago. The railroad equipment was delivered on the ground and ready to work May 20.

The industrial railroad was decided upon for hauling the material for several reasons, namely: The material could be delivered rapidly and by one unit, which could be easily supervised and depended upon; it could haul a load over the black earth roads even when water soaked, or in a condition that no other practical method of hauling could be used; it could be easily handled by convict labor and it could be worked overtime when desired.

The principal grading on the proposed system of roads was to prepare a subgrade or roadbed for the crushed stone. An elevating grader and heavy road grader were therefore purchased by the township and put in use preparing the roads for the hard surfacing material.

Three 10-ton steam rollers were furnished by the State Highway Department, together with the necessary accessories, such as sprinkling wagons, plows, harrows, tool boxes, etc.

A 30-horsepower steam tractor pulling engine for the graders was furnished by the State Highway Department; also six large wheel scrapers.

Because of the difficulty in securing teams in a farming community of this kind, team work was reduced to a minimum. A gasoline engine and pump and two miles of pipe line were installed for pumping water to the road for supplying the boilers of the steam rollers and for flushing the screenings into the macadam surface in preference to hauling the water by teams. Small creeks were so located over the township that two miles of pipe line delivered water to any portion of the roads to be improved.

UNLOADING DEVICE.

On account of the quantity of stone that had to be handled from one central plant and the necessity of having some device that would load the industrial train rapidly, it was decided to construct an unload-

Fig. 34. Industrial hauling outfit.

ing bin, and to use a belt and bucket elevator for carrying the material from the pit beneath the track, to the bin. The Santa Fe Railroad agreed to furnish the Roger Center Dump Cars on all shipments to this point.

The bin had a capacity of about 80 cubic yards, and was constructed so as to permit the dinky cars to pass under the center of the bin for loading. There were four trapdoors in the bottom of the bin, and the one and one-half cubic yard cars were filled in about five seconds. With the unloader, a minimum number of men were used at the unloading plant. The train of material was always made up quickly so there were no unnecessary delays for the locomotive. This insured efficiency in hauling. A secondhand 16-horsepower traction engine was purchased for driving the belt and for working the drum that spots the railroad cars over the pit.

With the device shown, 10 to 15 cars of stone could be unloaded daily, which readily supplied the one hauling outfit on the two and one-

half mile average haul. The locomotive hauled about 40 dump cars or 60 yards per trip and made from 6 to 10 trips per day.

YARDS.

The industrial tracks in the yards were laid so that there was but one move for the locomotive in the yards, and that one was to uncouple the empty train and to couple up with the loaded cars. On the first stop, the engine was supplied with water, coal and oil, which took about five minutes.

The switching in the yards was done with a horse. The empty cars were spotted and the loaded cars made up into a train for the locomotive. This arrangement saved time for the locomotive to the extent of an extra trip or two each day. The horse was purchased by the township, so the cost of the switching was small.

EXCAVATION.

The excavation was handled by a large traction engine, elevating grader, an ordinary engine grader and six wheel scrapers. All of this equipment was placed in charge of one man, who reported directly to the superintendent. The grading was completed as far in advance of the improvement as possible.

SUBGRADE.

The subgrade work was handled by one man, who had use of the tractor, grader and team leveller. He also had a squad of men for doing the necessary handwork.

HAULING.

All hauling was done with the locomotive and dump cars as shown in the accompanying pictures. The train crew consisted of an engineer, front and rear flagman. The steel track was first placed a little to one side of the center of the subgrade, and as soon as one dumping of stone had been made the track was shifted to the edge of the subgrade, where another dump was made to make up the required amount of material. The track was then shifted to the earth shoulder, and the necessary screenings and bonding materials dumped on the earth shoulder. When all material was dumped for about a mile of road, the track was picked up and extended on another route. Two or three men, known as track-walkers, were required to patrol the track and keep it lined up so that a maximum speed might be maintained by the locomotive.

SPREADING AND FINISHING.

All spreading, shaping and finishing of the macadam was under the direct charge of one man, who reported to the superintendent. The stone which had been dumped upon the subgrade was first spread by means of a team grader. After the material was evenly distributed over

the subgrade, a heavy harrow was hauled over the road to distribute the material more uniformly, and to sift the dirt and fine particles of stone to the bottom of the crushed material. After this was done, the earth shoulders were drawn up properly to the stone road and the finishing touches were made by men with stone forks and shovels. The road was rolled with the 10-ton rollers and if any depressions formed, they were immediately filled with additional stone. The road was then thoroughly rolled until no depressions were formed by the roller wheels and the stone was thoroughly compacted and keyed. The screenings were then whipped over the road from shovels and broomed and rolled in dry until all voids between the stones were filled, after which it was flushed with water, and puddled with the roller.

CONVICT CAMP.

The prison camp was officially known as "Camp Dunne."

Location.—The camp was located on a two-acre lot within one block of the postoffice at Reading, Illinois, and within three blocks of Moon Station on the Santa Fe Railroad. The camp ground was adjacent to a small creek which afforded good drainage.

Fig. 35. View of dining room in convict labor camp.

Equipment.—The camp consisted of the following: One plain building 18 by 60 feet, as shown in the cut. This building was partitioned off for a kitchen, dining room and officer's dining room. Adjacent to the kitchen was a good well, equipped with a small gasoline pump which supplied the washhouse and kitchen with an abundance of water.

An old building on the ground was utilized for a combination washroom and laundry. The washroom was supplied at all times with hot and cold water. Two convicts worked in the laundry. Everything washable was washed each week.

There was a barber chair adjacent to the washhouse, where the convicts received the necessary attention.

Two large tents 14 by 14 feet were located near the entrance to the camp ground. One was used by the officers and the other for the commissary department.

On the highest portion of the grounds there were located thirty 9 by 9 feet sleeping tents, each tent accommodating two men. All the tents were floored with lumber. Each man had his own bed and bedding, consisting of an iron bedstead, wire springs, mattresses, a pillow, blanket and linen. During cold weather the tents were supplied with small coal stoves so the camp could remain in use during severe weather, if needed.

Sanitation.—The entire camp was kept clean. No convict was permitted to commit any act which might cause filth. All garbage was carted away from the camp. The kitchen, dining room and outhouses were all screened to keep out insects. Precautions were taken to prevent the breeding of flies and mosquitoes.

Each convict was required to take a bath at least once each week. He was permitted to take as many baths as he desired. The camp, as a

Fig. 36. Building erected for dining room and kitchen for a convict labor camp.

whole, looked much better than the ordinary construction camp, in fact, it compared favorably with the best kept home with respect to sanitation.

Clothing.—An expert tailor, having good equipment, was kept constantly at work repairing, altering and making garments. All garments were inspected at least once each week, and buttonholes, tears and weak spots were repaired without delay.

The convicts were permitted to wear ordinary citizen's clothes, so it was very hard to distinguish prison labor from free labor. Most of the convicts dressed up on Sunday in made over clothing, which had been given to them by their friends or donated to the camp. Donations were always welcomed by the prisoners.

Rules and Privileges.—The camp rules were simple, but strict obedience to them was required. No convict was permitted to indulge in any form of disorderly conduct. Gambling and drinking were barred from the camp. The men had to be either in the camp or on their work and were not permitted to loiter about the community. They were re-

quired to arise at 5:30 a. m., be ready for breakfast at 6:00 a. m., and on their work at 6:45 a. m. Their dinner hour was from 11:45 to 12:45. Quitting time was 5:00 p. m. Supper was served at 6:00 p. m. and all lights were out at 9:30 p. m.

No road work was required of the men on Saturday afternoon, Sundays and holidays.

During leisure hours they were permitted to enter into any beneficial form of recreation. Each person was permitted to write one letter per day and to receive visitors every Saturday afternoon. There was no limit on the mail the convicts could receive.

The convicts were permitted to earn money when there was an occasion to work overtime on the road. They also made small amounts selling souvenirs to visitors. They were not permitted to have any money in their possession. Each convict was furnished with a pass book in which credit and debit were entered as fast as money was earned or expended. His balance was turned over to him on the completion of his sentence.

Fig. 37. Sleeping tents for men at convict labor camp.

Supplies.—The convicts were supplied with three good meals each day. Practically all their food was prepared at the camp.

The State furnished the convicts with all the chewing and smoking tobacco they cared to use. Those who preferred not to use tobacco furnished by the State were permitted to purchase tobacco and cigars at cost from the commissary.

Convict Work.—The road camps that have been sent out from the penitentiary had men selected for the various divisions of work. Each man was assigned to some particular work and kept at that one thing as much as possible, which insured the best results.

In the camp at Reading there were forty-six convicts. Ten were assigned to camp duties and thirty-six to actual work on the road.

The ten men at the camp were assigned as follows: The first and second cooks superintended the kitchen, and four assistants looked after the dining room, the delivery of field dinners, and many other small

details about the camp. There were two men in charge of the laundry, one in charge of the tailoring department and one general clerk.

Of the thirty-six men that were on the road, eight were assigned to the unloading plant, about six to the hauling gang, four to subgrade work and the balance to spreading and shaping stone and screenings. The men on road work were not definitely assigned, but were shifted from one division of work to another as the superintendent saw fit.

The men were at their work nine hours each day and any part of rainy days that it was possible to work. When the men were working several miles from camp, meals were carted to them by one of the dining room assistants, so there was no loss of time in reporting back to camp for meals.

There were two crews for the industrial railroad hauling system. One crew went on at daylight and worked until noon. The other crew operated the equipment until dark. The crews relieved one another at meal time so there was no loss of time during meal hours or when it was light enough to handle the equipment.

No guards were placed over the men at any time. They were merely counted twice a day to make sure they were all on the job. The men were permitted to work with free labor, by themselves, or in groups, as the superintendent saw fit. So far the road camps have been handled in such a way that it would be difficult for an outsider to determine a prison camp from the ordinary free labor camp.

The following statement shows the cost of establishing this convict camp and the actual cost per man per day during the entire period the camp was maintained.

TABLE XX—COST OF CONVICT LABOR CAMP—READING TOWNSHIP, LIVINGSTON COUNTY, 1915.

Time of men—			
Total unit days actually worked on road by convicts	6,843 days		
Total unit days not worked, Sundays and holidays	1,531 days		
		8,374 days at 50c per day	$4,187.00
Total amount paid guards			926.72
Total cost of establishing and maintaining convict labor camp—			
Lumber and building material	$636.48		
Salvage	174.15		
		$462.33	
Free labor		79.13	
Freight and transportation		109.57	
Coal		280.43	
Incidental supplies		52.62	
Men on camp duty at 50 cents per day—1,561 days		780.50	
Livery hire		252.30	
Estimated cost of transporting convicts to and from the work		150.00	
			2,166.88
Total cost			$7,280.60

Actual cost per man per day worked on road, $1.06.
Total cost per man per day in camp, $0.735.

An examination of these figures shows the marked economy of the camp. This economy together with the benefits derived from its humanitarian standpoint certainly warrant the establishment of such camps at as many points in the State as possible. It is believed that the conditions under which convicts are used for road work in Illinois are excellent and that these conditions set a standard which other states may profitably emulate. It is hoped that the use of convicts in this

capacity will grow more and more popular in the mind of the people with the result that the conditions of the State's prisoners will be improved, and the better roads movement will be given an added impetus.

EVILS OF AN INADEQUATE TOWNSHIP SYSTEM AND THE NEED OF REFORM.

One of the greatest detriments to our country roads can undoubtedly be charged to methods which have been followed in supervising the work.

The blame can not fairly be attached to the highway commissioner. He is forced, by local sentiment, to do many things contrary to his own views, and contrary to standard practices heretofore established. The highway commissioner who is not willing to yield to the suggestion of a majority of taxpayers is forced to terminate his services at the next election.

The highway commissioner, with practical ideas and with definite plans in view, is frequently beaten at the polls on account of the system and on account of failure of the voters to understand many of the fundamental principles that govern road construction and maintenance. The result, therefore, is the changing of road officials every few years. The new official has new ideas, new obligations, and the public highways suffer the results. Again, an incompetent highway commissioner may be able to secure the necessary votes to hold him in office for a great many years. Quite often a highway commissioner may be found whose entire ambition is to hold office or beat the other candidate at the election. Such public officials have very little regard for the betterment of the public highways.

Again it is optional with the voters whether they want three highway commissioners or one highway commissioner to oversee the road work in each township or road district. Here again, the voters may be influenced for or against the three-highway-commissioners system. They may be against the single-highway-commissioner system because they are not familiar with its advantages. They may be against it on account of the fear of some incompetent candidate who is sure to control the majority of votes. It is evident that one incompetent highway commissioner with the control he has of public funds, is worse than taking chances on three.

The single-highway-commissioner system, has, without question, many advantages over the system using three, provided a township is successful in securing the services of a competent man. However, under the present system of electing commissioners by popular vote every three years, regardless of their ability, the efficiency of even the single-commissioner system is very materially reduced.

In view of existing conditions, it seems necessary that some other than electing the highway commissioners by popular vote, involving possibly a modification of the present system, must be developed to insure more economic results on the public highways. The big corporations and business men of to-day are looking for trained men to handle their various divisions of work. It is evident that the railroad companies

and business corporations could not exist if the heads of the various departments, or the men that do things, were given their places by popular vote of the people. Yet much of the public work is trying to exist under such conditions.

The time is not far distant when the majority of taxpayers will see the fallacy of the old method and will demand that our public road work be handled in a more efficient and business-like way.

The most advanced and efficient work of to-day is handled by trained men. It seems evident therefore, that some scheme should be devised that will insure that all road officials are especially fitted for their work before being placed in office, and after they are once in office, that their term be not less than six years. To determine the fitness of candidates for the office of highway commissioner they should meet certain qualifications that should be prescribed by the Chief State Highway Engineer through the county superintendent of highways. The qualifications ought to have the approval of the State Highway Department so as to make them as near uniform throughout the State as conditions will permit. The candidates who have passed or who meet the prescribed qualifications may then be voted on at a regular township election. The man receiving the highest number of votes should be the highway commissioner of the township or road district.

Business organizations or corporations of any kind always subject their candidates for employment to a rigid examination before employing. The examination may consist of a personal interview where the candidate is required to give a complete outline of his experience together with references as may be required, or a written examination where similar information may be demanded. The method of examining may depend upon the nature of the work. The main thing to note is that corporations do require that their employees be qualified for the position they hold. Another point is that practically all employees of a business concern or corporation are responsible to someone above them. These are points that make for efficiency and, without question, would prove to be of benefit to township organization if they could be established.

Under the present system of township or road district organization, the commissioners are not responsible to anyone, and the results are diversified opinions and methods concerning road work. Centralization of responsibility and authority insures efficiency. It would seem, therefore, that the men doing the actual road work in a township or road district should report direct to a single highway commissioner, he in turn to the county superintendent of highways and the county superintendent of highways to the Chief State Highway Engineer.

TOWNSHIP ROAD MACHINERY.

Up to the present time a vast amount of money has been spent for road machinery by the townships in the State. About 33 per cent of all the money spent on roads and bridges has been spent in this way. When it is realized that about seven million dollars per year are being spent by the townships alone for road and bridge purposes it is evident that there

must be in this State either a comprehensive supply of road building machinery or a vast amount of junk.

It is deplorable that much of the machinery purchased has gone to the junk pile long before it should. One of the greatest causes of this condition is that the machinery has been badly neglected. It has been used only a small portion of the year and then has been left to rust out in a fence corner. Proper greasing, painting and housing would have extended the life of this machinery many years. In order to protect the road machinery it should be housed at all times it is not in use.

Much machinery has been purchased by the townships which they cannot profitably own. It is a common occurrence to find in a township high priced power tractors, heavy engine graders and road levelers. These machines are used a few days each year and remain idle for the remainder of the time. It is evident that such machinery is inefficient unless it is used a large part of the time. The interest on the original

Fig. 38. Much of our township road machinery is quickly ruined by such storage as this.

investment, and the rapid depreciation are so great that constant usage is required to make such machines efficient. Any farmer, or manufacturer, using machinery, who analyzes his costs will vouch for the fact that a machine must not only be efficient when operating, but must also be operated a great portion of the time if its cost can be justified. The same rule applies to township work.

The questions naturally arise. What shall the township do? What is the solution of the problem? County ownership of heavy road building equipment will be the solution. The county can place experienced operators in charge of heavy equipment and then loan it to townships at actual cost of operation. This method enables the township to reap

the benefits of heavy equipment and experienced operators without paying the high overhead expense. The county on the other hand can keep this machinery in use a large portion of the year by transferring it from one township to the other.

There is no question but that the township should own all light equipment such as slip scrapers, light graders, plows and drags. This machinery has a low first cost and small depreciation. Consequently its ownership by the township is justifiable. Such equipment should be properly cleaned, greased and housed when not in use.

It is firmly believed that the adoption of these suggestions by counties and townships would result in a great saving and eliminate the present woeful waste of funds in the purchase of road machinery throughout the State.

GOOD ROADS DAY.

In Illinois and neighboring states there has grown up the practice of designating certain days for improving the roads by the concentrated effort of the State as a whole. The awakening of the interest of the general public has been one of the fundamental reasons for instituting this custom because the creation of good roads enthusiasm will in the end have far more reaching effects than any actual road work which may be done. A secondary function of the good roads day is to accomplish some specific work to ameliorate conditions on the public highways.

It is, therefore, evident that in formulating a plan for carrying out the good roads day program, unlimited advertising should be used. The proposition should have the official sanction of the State which of course takes the form of a proclamation from the Governor. Aside from the benefit derived from the interest thus shown by the Governor as an individual citizen, the official recognition on the part of the State administration has a profound effect in producing interest on the part of the public as a whole.

Owing to the fact that the State Highway Department is closely in touch with all matters pertaining to road improvement it is logical that the administration of this work be handled by that department. That office in turn should seek the cooperation of the various good roads associations, the marked through route associations, automobile interests, city governments and county and township officials. Through the united efforts of all these interests the campaign of advertising could be carried out in the form of public meetings and newspaper articles prior to Good Roads Day.

In order that the plans for the actual road work may be carried to a successful conclusion a careful organization of committees is required. The State Highway Department should see that committees are chosen to represent all the good roads associations and marked through route associations. In each county there should be a general executive committee to see that all other committees are working smoothly. Under this committee should be county committees for a specific branch of work. These committees should direct the work of similar committees in the townships. Throughout the township men should be appointed to super-

intend the road work and to see that the men are instructed as to where to report and what to do. This man should make a careful inspection of the section of road he is to superintend, make a careful inventory of tools and equipment needed and see that the same are on the job in advance of the work. Every detail should be carefully planned so that confusion will be absent on the day of the work.

Needless to say the women of the community can assist greatly by arranging to serve meals to the workers. If it is properly handled the event may take the form of a community picnic by which social intercourse will be promoted and neighborhood pride created.

It is necessary if proper benefits from this day are to be derived, that speakers be provided to discuss various matters relating to roads. The program of speeches may be arranged to occupy the noon hour when a gathering of the workers can be obtained. It may be advisable in some localities to confine the day's events to speaking and similar means of arousing enthusiasm.

It is useless to discuss all possible details for making a Good Roads Day successful. Different conditions require different methods. The fundamental of success is "push" and a generous amount of the latter should be used regardless of what program is to be carried out. In this manner Good Roads Day can be made a success.

It is hoped that the various states may cooperate to make Good Roads Day a National event. A proclamation could be issued by the President of the United States. This general proclamation could then be followed by one from each Governor. In this manner the country as a whole may be united in this road celebration so that public interest may be aroused. It is believed that such a procedure would prove to be of lasting benefit in securing more work on the roads, in securing constructive road legislation and funds for road building.

MARKED THROUGH ROUTES.

A few years ago such a thing as a route definitely named and marked for the guidance of the traveling public was unknown. Roads were known locally, and were considered only from the local standpoint. The possibility of a road having a relation to other states or to the country at large was not realized. Consequently, the conditions of the roads in various communities have depended upon the enterprise and progressiveness of those communities alone. Since the era of the automobile, with the attending promotion of marked through routes, a great impetus has been given to the improved roads movement. The organized interests of the through route associations have assisted isolated communities and have induced them to improve their roads. This has resulted in definite action being taken by each individual locally in such a manner as to carry out one general policy as outlined by the association promoting the route.

Practically all of the marked routes have been financed and promoted by perfected organizations of interested men and women. Men of national reputation, together with the most humble person along the route, have been closely identified with this movement. The combina-

tion of the efforts of all the interested people between these two extremes has resulted in a movement which has awakened the whole country to a realization of the fact that the time for definite action concerning the road problem is at hand. Strength always results from organization, and the strength obtained by uniting the interest of the general public far surpasses any possessed by State and county officials or isolated road legislation.

A large amount of enthusiasm has been displayed by automobile users. From the standpoint of the automobile tourist the through routes marked at frequent intervals by some conspicuous sign are very desirable. Traveling is much more pleasent when there is no danger of losing the way. Likewise hotel and garage accommodations are much better for the tourist if the bulk of the traffic proceeds along one route.

Through routes have also received the support of the automobile manufacturers. Aside from the general standpoint of public welfare, such producers have been able to advance their own interests by cooperating with the various highway associations. Through routes mean better roads, better roads mean more tourists, more tourists mean more automobiles, more automobiles mean more business.

The results obtained by the important through route organizations far surpass the expectations of even the most optimistic promoters. The roads have been dragged and graded, permanent culverts and bridges built, and in many places the roads have been improved with some form of hard wearing surface. Local officials have cooperated with the promoters of these highways so that a large part of the money spent locally has been used on these routes. Naturally this has hastened the improvement far beyond the rate which would have prevailed if hit-or-miss methods were followed without any definite object in view.

The marking signs used so far on the through routes have consisted largely of various colored bands and symbols, painted on telephone poles or other roadside structures. This system of marking might be generally improved in the future if some more permanent marker were used. This idea might be carried out as the route became constructed of the more permanent types of pavement. In this manner the improved stretches might be honored by the more permanent marking system while the unimproved portions would be simply designated by blazing a trail of colors on the telephone poles.

The fundamental purpose of the State aid law in Illinois is to obtain a network of through roads. The policy of the State administration, the State Highway Commission and the Chief State Highway Engineer has been to bend every effort toward a State wide system of roads which will serve local, State and through traffic. The influence of the department has been used in all cases to secure the type of road which suited the traffic conditions, and to require proper construction and maintenance of the types chosen. All matters pertaining to State aid roads have been administered in such a manner as to benefit the system as a whole rather than to cater to any narrow local prejudices.

It is plain that this policy has met with popular approval. This approval has been manifested by the formation of the various associations promoting through routes. These promoters are demanding in an un-

DETROIT
GRANT HIGHWAY
CHICAGO TRAIL
OREGON
DIXON STAMPED ROCK TRAIL
K.C.-BELT
BLUE
CAMBRIDGE
TOULON
INDIAN HEAD
DIAMOND
MORRISON
MT. CARROLL
MORRIS
OTTAWA
LASALLE
PRINCETON
GENESEO
KEWANEE
GALESBURG

DUBUQUE

TRAIL
SWASTIKA
MAIN
ROUTE

official way the same through system as is advocated by the State law and the State Highway Department. The cooperation of these official and unofficial interests naturally proves beneficial to the road system.

The State Highway Department is heartily in sympathy with the movement to establish marked through routes because in this manner the cause of better roads is served. In order to assist this movement, a map has been prepared by the department showing the through routes established up to date. It is believed that proper publicity may be given these routes in this manner and that their importance may be more apparent if official recognition is given. Figure 1 shows the map of marked through routes in the State. There may be some small errors in the minor routes, and in some cases incomplete information prohibited showing a route in full. The information shown, however, is believed to be correct. A glance at this map shows the magnitude of the work which has been done in Illinois alone.

It will be noted that the through routes closely follow the State aid routes. As a general rule it may be said that the State aid roads which follow the through routes are the most important ones. In addition to local traffic they accommodate fast-moving traffic, which might be compared to that carried by the main passenger lines on a railroad. The remaining State aid roads may well be compared to the spur lines which carry local passenger traffic and freight. In designing the State aid system this fact should be taken into account, and a width and type chosen which will best accommodate the conditions. In general the State aid roads which serve through traffic as well as local traffic should be constructed first. The types and widths chosen for through roads should be such as will carry fast-moving automobile traffic. By handling this work in the manner outlined, the purpose of both State aid roads and through routes will have been fulfilled, and the most people will have been served.

In view of the fact that much duplication of marking has occurred on some of the main highways, due to the adoption of the same route by several associations, it seems advisable to protect the traveling public from confusion by placing this trail marking under the general control of the State Highway Department. By taking this step much duplication of work may be avoided, confusion eliminated, and the strength of the various highway associations correlated without in any way impairing the present wholesome enthusiasm for highway promotion.

It is to be hoped that the extensive plans which the various through highway associations have under way will be carried to a successful conclusion, and that the praiseworthy effort of these organizations will be strengthened and honored by the support of the public at large.

DISTRIBUTION OF CRUSHED STONE PREPARED AT THE PENITENTIARIES.

The following statements cover the law concerning the preparation of crushed stone, the methods and rules followed in its distribution and a brief outline of how the material should be used.

Law regarding convict labor on road material, etc. An act to amend section 2 of an act entitled, "An Act authorizing and empowering the employment of convicts and prisoners in the penal and reformatory institutions of the State of Illinois in the manufacture of tile and culvert pipe for road drainage purposes, and in the manufacture of machinery, tools and appliances for the building, maintaining and repairing of the wagon roads of the State, and for preparing road building and ballasting material, upon the requisition of the State Highway Commission," approved May 18, 1905, in force July 1, 1905.

SECTION 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly:* That section 2 of an act entitled, "An Act authorizing and empowering the employment of convicts and prisoners in the penal and reformatory institutions of the State of Illinois in the manufacture of machinery, tools and appliances for the building, maintaining and repairing of the wagon roads of the State; and for preparing road building and ballasting material upon the requisition of the State Highway Commission," approved May 18, 1905, be and the same is hereby amended to read as follows:

Pp. 2. The commissioners of highways in any township in counties under township organization or the commissioners of highways or boards of county commissioners in counties not under township organization, may make application to the said State Highway Commission for such road building material, tile, culvert pipe, road making machinery, tools and other appliances as may be needed or required by them for the construction, improvement or repairing of the wagon roads in their respective townships or road districts, and where by agreement of the commissioners of highways in counties under township organization, or the commissioners of highways or boards of county commissioners in counties not under township organization, as the case may be, with the city council of any city, or the board of trustees of any village within the limits of such town, any gravel, rock, macadam or other hard road is extended within or through the corporate limits of such city or village then for the construction, improvement or repairing of so much of said road as lies within the corporate limits of such city or village, provided such extension within such city or village shall be of the same cost and kind of material as the road outside such city or village, obligating themselves to use such material according to the rules and regulations formulated and approved by the State Highway Commission.

Approved June 3, 1907.

CONVICT LABOR PREPARES CRUSHED STONE.

It will be noted from the statutes quoted above that the prisoners from the penal and reformatory institutions of the State of Illinois are permitted to manufacture various materials that may be used upon the public highways.

Illinois, since 1906, has been using the convicts of the Joliet and Menard penitentiaries in preparing crushed stone for road improvement. Since 1913 it has established honor convict camps on the public roads for doing the roadwork. The convict camps that have been established in the field have so far proved satisfactory. However, there are many convicts that are not considered safe in honor camps on the public highways, and it is necessary to confine them to the prison or barricade, where they may be properly guarded. It seems therefore entirely practical to have the convicts prepare crushed stone, that it may be supplied to the field camps, townships, and road districts that are desirous of improving the public highways.

The employment of convict labor in the open air and yet inside the penitentiaries or within stockades, where the method of guarding and

the precaution taken against escape are practical, has so far proven to be humane and efficient.

Under these conditions there is no additional expense to the taxpayers at large for the product of convict labor, and whatever road materials are produced result in a clear gain by the community.

The preparation of crushed stone interferes but very little with existing industries, as the crushed stone is, in almost every instance, used in supplying convict camps and townships, where it would not be used unless it could be secured at the especially low rates, which this method of production secures.

It has been thoroughly demonstrated in many districts that it has created industries rather than interfered with them. The total output

Fig. 40. There is a wealth of undeveloped deposits of road building material in Illinois.

of crushed stone from the prisoners is a comparatively small part of what is required for the extensive road improvement usually under consideration.

There are many other features that commend this method of cooperation, for example the fact that a demand for much free labor is created by the construction of roads, which but for free stone would not in many instances be undertaken. It will readily be seen that many localities are greatly benefited by securing the free stone, and no locality is at any increased expense for its preparation, even tho they may not secure any of the material.

ADDITIONAL MATERIAL IS NEEDED TO SUPPLY THE DEMAND.

Elsewhere in this report will be found tables and charts showing the amount of material that has been requested, and the amounts supplied since 1906. It will readily be noted that the demand for the material is far greater than the present supply.

It would seem advisable, therefore, if this work is to be carried on, that some means should be devised whereby a certain number of convicts could be established at other points in the State. Stone depots should be established at points where a suitable quality and quantity of material could be had, and where transportation facilities would enable the material to be delivered to points that have not been able to secure stone from the present plant, on account of the excessive freight rates.

It has been noted that a community interest in road improvements depends largely on the price they must pay for road material. It has also been noted that where a community has a few miles of improved roads, it is always desirous of securing an additional mileage.

It would seem, therefore, that special attention should be given to establishing stone or gravel depots, at or near points where there has been very little road work undertaken.

Other Road Material.—It will be noted that the law permits the penal and reformatory institutions of the State to manufacture tile culvert pipes, machinery, tools and appliances for building, maintaining and repairing of the wagon roads of the State. On account of the large demand for road building material, and the comparatively small demand for other material enumerated, practically all attention of the prison authorities has been directed along the line of preparing crushed stone, and to date there have been no other materials manufactured for the public highways.

TABLE XXI—DISTRIBUTION OF CRUSHED STONE FROM THE PENITENTIARIES FROM 1906 TO 1916.

Year.	Total amount of applications.	Number of counties receiving material.	Number of townships receiving material.	Cubic yards of stone shipped.
1906	276,365	57	127	39,905
1907	166,140	39	72	96,595
1908	100,680	30	54	120,240
1909	227,690	40	75	136,789
1910	143,830	42	67	103,309
1911	214,434	40	80	152,165
1912	263,195	43	90	154,032
1913	233,130	41	100	152,572
1914	226,832	36	80	136,721
1915	169,819	38	91	144,462
1916	131,662	24	74	105,398

RULES GOVERNING THE DISTRIBUTION OF CRUSHED STONE.

Inasmuch as the statutes require all stone shipments from the penitentiary to be made upon the requisition of the State Highway Commission, and that all requests from the highway commissioners and road

district or county commissioners, shall be made to the commission it is evident that certain rules must be observed to insure fair distribution of the material.

The following rules have been issued as a guide for the distribution of the crushed stone prepared at the penitentiaries:

1. *All applications concerning crushed stone shall be made to the State Highway Commission, Springfield, Illinois.* Applications for material shall be made on regular forms furnished by the department.

2. Each application for material shall be signed by the local highway commissioners and approved by the county superintendent of highways who thereby agree to see that the material is used according to the rules and regulations prescribed by the State Highway Department.

3. Each application is given a serial number, upon its receipt and stone shipments are made in the order of the receipt of application, with the exception that special consideration is given to points where convict labor is employed, where State machinery is working and to points in territory which has not previously received material.

4. The State Highway Department maintains as far as possible, general supervision over all work done, where materials are furnished by the State.

5. Standard methods for construction of gravel and macadam roads are outlined herein, and it is expected that these instructions will be followed as closely as conditions will permit. Other instructions are issued as special conditions and individual cases may require.

6. When material supplied is not used in accordance with the instructions, shipments are discontinued and not started again on the same application until proper agreement has been made with the Chief State Highway Engineer concerning the use of the material.

7. Each application for material must be accompanied with a complete statement of conditions under which the material will be used, and other general information concerning the proposed work that will satisfy the department that the improvement will be of benefit to the general public.

8. When possible, an engineer visits the site of the proposed improvement, before application for material is granted.

9. No application for less than 500 cubic yards of stone is considered, unless the material is to be used in extending, repairing or maintaining an existing improved road.

10. All crushed stone shipped out from the penitentiaries for road purposes is free f. o. b. cars at the penitentiary.

11. No township or road district is allowed in any twelve consecutive months more than 3,000 cubic yards of stone, unless so ordered by the Chief State Highway Engineer or the State Highway Commission. This rule would not apply if there are no other applications on file on which stone shipments could be made.

12. Before any shipments are made, notice is given to the local officials so that arrangements can be made for taking care of the material. If it is found that the material cannot be handled at the time designated, shipments are delayed for a period not exceeding 30 days. If shipments are delayed more than 30 days, the application is re-numbered and taken

up in the order with other applications that were received on the date shipments were ordered stopped.

GENERAL INFORMATION CONCERNING DISTRIBUTION.

During the four years covered by this report a number of applications for crushed stone had to be considered which had been filed prior to 1913 but upon which no shipments had been made on account of shortage of material. These applications which were carried over together with the ones received during the three years have constituted a demand for the crushed stone far in excess of the supply. In the distribution of crushed stone every possible effort has been made to distribute the material in the order of receipt of the applications at the office. It has not always been possible to do this, as in many cases the townships were not in a position to handle the material when it was available, again there was often a shortage of railroad cars which prevented shipments going forward in the order as desired. This often confused shipments so it was impossible, at all times, to take up applications in the order of their receipt.

There have been some townships that requested crushed stone far in excess of their proportionate part, so it became necessary to limit the amount of crushed stone to any one township to 3,000 cubic yards in any one season. While it was not intended to prevent any one township from getting the full amount of their application for crushed stone, it is clearly shown from the tables of distribution that it was not possible to supply the demand and it was therefore considered more just to all concerned if the amount of material shipped to any one place during one year be limited to an amount sufficient to improve approximately one mile of road. In a few places where the State machinery was working, where convict labor was being used, or where some special work of an experimental nature was undertaken it was necessary to ship the full amount of material needed to complete the work under consideration.

Before any shipment is made the lowest freight rate is ascertained and notice sent to local officials accordingly. The rate on crushed stone from the penitentiaries is the same as that for commercial material, the local freight agents, therefore, are usually able to advise the highway commissioners direct in regard to the through published rate.

At the Joliet penitentiary, the material may be loaded directly upon the E., J. & E. or C. & A. tracks, without switching charge, but where material is shipped over other roads out of Joliet, there will usually be charged a two dollar ($2) switching fee.

At the Menard penitentiary, material is loaded directly on W., C. & W. and Iron Mountain tracks, and shipments made over other lines from this point usually have a switching charge. A number of the railroads quote rates to certain points, including all switching charges, that is, the switching is absorbed by the rate.

Where stone shipments are ordered to points that do not have a local agent, arrangements are made between the highway commissioners and the warden or railroad agent at the penitentiary, to prepay freight.

On account of the irregularity of stone shipments from the penitentiary, the heavy demand made upon the supply during the construction season, it has been found advisable in a great many cases to ship the stone during the winter months, when weather is unfavorable for construction work. In such cases the material is unloaded in a storage pile at some convenient siding. The many advantages gained by having a storage pile to draw upon during the busy construction period, more than offset the small expense of rehandling the material.

When a portion of the material is shipped out during the winter months, it allows the penitentiary to work its full force continually, and in this way a greater number of townships and road districts are supplied with the materials desired.

There are four sizes of stone usually supplied by the penitentiaries; they are known as riprap stone, the two and one-half inch stone, stone chips and stone screenings. The riprap is a one-man size stone; the two and one-half inch stone will vary from one to two and one-half inches in size. The stone chips vary from one inch to one-half inch, and the screenings from one-half inch to dust. The ratio of one car of screenings or chips to four or five cars of 2½ inch stone is about the way material is crushed at the quarry, and it is shipped out in this proportion, unless otherwise specified. No applications for all screenings or chips is filled unless especially requested. The full amount of an application may be supplied with the 2½ inch stone or riprap stone if so requested.

Demurrage.—The following agreement is adopted by most of the railroads in assessment of demurrage:

Section (a). A credit of one day will be allowed for each car released within the first twenty-four hours of free time. A debit of one day will be charged for each twenty-four hours, or a fraction thereof, that a car is retained beyond the first forty-eight hours of free time. In no case shall more than one day's credit be allowed on any one car, and in no case shall more than five day's credit be applied in cancellation of debt accruing on any one car, making a maximum of seven days that any car may be held free, this is to include Sundays and holidays.

Section (b). At the end of the calendar month, the total number of days credited will be deducted from the total number of days debited, and one dollar ($1) per day charged for the remainder. If the credit equal or exceeds the debit, no charge will be made for the detention of the car, and no payment will be made to shippers or receivers on account of such excess and credit, nor shall the credit in excess of the debit of any one month be considered in computing the average detention for another month.

RULES CONCERNING THE USE OF CRUSHED STONE FROM THE PENITENTIARIES.

1. The crushed stone shall be used only in the construction of continuous stretches of road, or repairing previously improved roads.

2. No material will be furnished for improving roads that are improperly drained.

3. No material will be furnished for constructing roads less than nine feet in width, or less than eight inches thick, or more than eighteen inches thick. The thickness may be reduced in surfacing previously improved roads.

4. No material is furnished for building bridges, culverts, retaining walls or fixing approaches to bridges, except when such structures are on the road being improved with penitentiary stone. The use of stone for filling mud holes, or for building less than ¼ mile of continuous public road is not permitted.

5. The material is to be used exclusively upon the public highways.

6. The material may be used on streets inside the corporate limits of cities or villages of less than 10,000 population, provided it be used under the direction of the highway commissioners and on a street that is a continuation of a rural public highway.

STANDARD METHOD FOR CONSTRUCTING CRUSHED STONE ROADS.

Many inquiries have been received as to the best method to be followed in constructing stone and gravel roads. This necessitates issuing instructions as listed above and describing standard methods of procedure in the use of crushed stone. There is some difficulty in giving precise directions which would cover all cases under which stone roads are constructed. The main object in outlining the method that should be followed in the construction of such roads, is to insure that the material that will not be wasted, and that it will be used according to the best known methods.

In a great many instances, the crushed stone is the first material of its kind that has been used in the township, and proper results are quite important to the future development of road improvements.

A few serious objections have been raised against some township road improvement work, namely, that the officials are inexperienced in road construction, and that they are in many cases limited to a small amount of money with the result that the best methods are not always used. However, these objections seem to confront the average township or road district for many years to come, consequently the rule is to make the best of conditions as they exist. The following methods are given to aid the officials in securing good results.

In only a few instances are rollers owned by township or road districts, so it is necessary that a great many roads be improved without the use of a roller. Many of the suggestions offered, therefore, will be such that will insure the best results under such undesirable conditions.

Preparing the Road-bed.—There seems to be a great temptation to neglect the preparation of the road-bed on which the crushed stone is to be placed. The road-bed is usually roughed out and all depressions, holes, ruts, etc., are filled with stone in preference to earth, even though earth is many times cheaper and in many cases more desirable. The old saying of "A chain is no stronger than its weakest link," can readily be applied to road surfaces. The most efficient road is the one constructed so as to give an absolute uniform wearing surface of the materials used.

This cannot be accomplished unless the stone is spread uniformly over the road-bed. If the stone is thicker in some places than others, it will not be compacted uniformly, and depressions will form in the wearing surface.

Too much emphasis cannot be placed upon the proper draining and shaping of the road-bed, preparatory to placing a stone wearing surface. It is advisable to prepare the road-bed by cutting down hills, filling hollows, ruts, depressions, etc., as far in advance of placing the material as possible, in order that the rains and traffic will thoroughly compact it. Where a road-bed is prepared immediately in advance of the material, and where no roller is available, it is desirable to use a traction engine for grading and compacting the road-bed.

To prevent the traffic from forming ruts in the subgrade, arrangements should be made to go over the surface occasionally with a drag or

Fig. 41. Tons of stone are wasted when dumped upon a rutted subgrade.

grader. This keeps the surface smooth and uniformly compacted, before material is placed.

Side Ditches.—Where the road runs through level country, the side ditches should be as broad as possible, and not less than 30 inches below the crown of the finished road. The broad side ditches will permit the roadside to be mowed with a power mowing machine, and this will aid in keeping up the appearance of the road by preventing a rank growth of weeds and by permitting the banks to become covered with sod. The broad ditches will also take care of flood waters more readily and prevent wash-outs in the road. The slope on the side of the ditch next to the road should be about four to one, that is, four feet horizontally to one foot vertically. The slope next to the fence should be from two to one, to four to one, where possible.

Embankments.—Through low swampy places, and at many places that are subjected to overflow, it is necessary to throw up a considerable embankment, so that the road-bed is raised above the surrounding land and above all the high water marks. Embankments should be constructed at least 20 feet wide on top, and wider if possible, with ample side slopes so that the embankment will readily stand and not slough off at the edges. The side slopes of embankments should be about two horizontal to one vertical to insure the best results. High embankments should be protected by constructing a heavy guard fence at the sides.

Earth Side Roads and Shoulders.—The accepted method of constructing macadam roads is to plow or scrape out a trench to receive the stone and to obtain earth for building side roads. The intention is, that the firm earth shoulders shall hold the stone in place and prevent spreading of the material.

Fig. 42. Spreading stone with grader.

Wherever stone or gravel roads are constructed one or two earth side roads should be provided. The earth side roads will take the traffic during the dry season and in this way lengthen the life of the hard road.

There is usually considerable argument as to whether the best position for a hard road is in the center of the public road or at the right hand side going to the market center. In general it may be said that the center of the highway is the most desirable position for an improved surface. The center construction permits a better looking road, one that is more easily drained and safer to traffic. In case a single track improvement only is required and the highway is narrow it may be more desirable to place the metal wearing surface to one side so as to provide for a good earth road.

Under Drains.—The under drains on any type of road constructed should be carefully laid out to insure the best results. There are a

great many roads, particularly through low, flat land and on seepy hillsides that require tiling before the road is improved. A careful survey of the road should be made by a competent engineer and a system of tiling laid out that will properly drain the road and remove the underground water.

In addition to the tiling that may be necessary, additional stone drains should be constructed to permit surface water to enter the tile. Blind stone drains should be constructed at intervals along the road, by digging a narrow trench entirely across the subgrade and to the open side ditches. These trenches should be filled with stone or coarse gravel to a depth of about 6 inches, after which they may be filled with earth so the drains do not show from the surface of the shoulder. Where the stone road is constructed at one side of the center line of the road, the stone drains should open into the side ditch adjacent to the metal surface.

Spreading Stone.—The stone may first be dumped directly upon the road-bed and in such quantities as will make the desired thickness of material.

The following table will serve as a guide in dumping the proper amount of material:

TABLE XXII.

Width of improvement in feet.	Thickness of stone loose—inches.	Stone required per mile of road—cubic yards.	Stone required per linear foot of road—cubic yards.	Screenings required per mile of road—cubic yards.	Screenings required per linear foot of road—cubic yards.	Stone required for drains, etc. approximate cubic yards.	Total stone and screenings required per mile of road—cubic yards.
9	10	1,465	0.277	350	0.066	15	1,830
10	10	1,630	0.309	390	0.074	15	2,035
12	10	1,950	0.369	470	0.089	14	2,434
14	10	2,280	0.432	550	0.105	14	2,840
15	10	2,440	0.462	585	0.110	12	3,037
16	10	2,600	0.493	625	0.118	12	3,237
18	10	2,930	0.555	700	0.132	10	3,640
20	10	3,260	0.617	785	0.149	10	4,055

The amount of screenings required for a mile of road depends largely on the way the stone road is rolled and the quality of screenings or bonding gravel used. The quantities given are in a majority of cases sufficient.

Where new roads are built it is preferable to have the material dumped and spread in two different courses, as the material can be spread more uniformly and will compact more readily. If it is planned to construct a road 8 inches thick when completed, the first course of stone should be evenly spread to a thickness of about five inches. The material may be spread by the use of a grader or stone forks. After each course of stone is uniformly spread, a strong toothed harrow should be dragged over the road several times. A heavy harrow will loosen up all tight and uneven pockets formed by dumping the material directly upon the foundation, and besides it will sift a large part of the dirt and finer particles in the stone to the bottom of the road and leave a more

uniform surface and one that will not be wavy after the road has been used.

It should be held in mind that about five inches of loose stone will compact under the roller to about four inches. A road built therefore of two, five inch layers of stone will compact to about 8 inches.

After the first course of stone has been rolled, or thoroughly compacted, it should if possible have a light application of screenings, sand or bonding gravel to fill the voids in the stone. The filling of the voids between the stones in the foundation course is quite often omitted, but it has been thoroughly demonstrated that it is well worth the extra cost.

Second Course.—The second course of stone should be spread in a manner similar to that indicated above, except that more care should be taken to get uniform material and to get it evenly spread over the lower course. The heavy harrow should be used on both courses of stone. Care should be taken to have the stone spread so that the edges of road will be straight lines and present a good appearance.

Screenings for Bonding Course.—After the stone road has been thoroughly rolled and the shoulders graded off to insure perfect drainage, a proper amount of screenings or bonding gravel should be dumped on the shoulders in convenient piles. The screenings or bonding gravel should then be whipped over the surface of the road from a shovel. If the fine screenings are applied in thin layers, they will sift down and fill the voids in the stone, they should then be broomed and rolled in successive layers until only a small amount of screenings will be left on the surface of the road. The screenings should be broomed and rolled several times dry, so that all voids in the stone are thoroughly filled. After the road refuses to take additional screenings, the entire surface should be sprinkled with water and immediately followed up with the roller. After the voids are all properly filled, some water will lie on top and the roller will make a thin slush that will thoroughly cement the road surface.

If no roller is available for finishing the road, only a portion of the required amount of screenings should be put on at first. The traffic should be allowed on the road a week or two after which all ruts formed may be filled with stone and the entire surface of the road screened. If the road is then watched carefully, and additional screenings added where there is any indication of raveling, the entire surface will compact uniformly. A small amount of good bonding gravel on the surface of a limestone road will aid in getting a good surface.

Where a road roller is not available, officials are inclined to use on the second course of stone a very large amount of fine stone or screenings. It is evident that the excess screenings and stone chips will give a good surface, yet it makes a road that is very dusty, and one that wears rapidly and is hard to maintain, particularly with surface oil treatments.

Filling Ruts.—It will be necessary in order to obtain the best results to arrange for someone to go over the improved road frequently and fill all ruts as they form and see that bonding gravel or screenings cover all spots that are inclined to ravel. If this is done throughout the first season the road will eventually become compacted and fairly smooth and

a satisfactory surface will result. This is particularly true where limestone is used, as it is comparatively soft and binds rapidly. Ruts or depressions that will hold water on the surface of an improved road will soon destroy it. Extra precautions therefore should be taken at all times to eliminate such causes of failure.

INSTRUCTIONS FOR PLACING GRAVEL.

Gravel roads may be built in much the same manner as macadam roads. Another practical method is the so-called "feather edge" construction. In this case the earth roadway is given a smooth, well crowned surface, and the gravel is placed directly on this with a maximum thickness of ten inches at the center and tapering to about four inches at the edges. A trenched subgrade is thus eliminated. Sufficient material is used in a fifteen foot road to be equal to a ten foot road of ten inches uniform thickness. Particular attention should be paid to thoroughly spreading and raking the gravel so that the finer parts are sifted to the bottom, leaving a layer of the larger pebbles and pieces of stone on the top to form a wearing surface.

There are many cases where gravel is found close at hand, but it is of such sandy nature that it will not form a good road surface. Such gravel can, however, be used to advantage at the bottom of the road which could then be covered with a four or five inch layer of crushed stone. In this way the crushed stone would go very much farther than if the road were built entirely of stone.

The usual method of constructing gravel roads, dumping the loads of gravel in two rows, and leaving it to be spread and compacted by traffic, causes far too much inconvenience and should not be permitted.

CARE OF THE ROAD SIDE.

Appearance counts. It is worth as much to the road as to the houses and grounds alongside it. A beautiful road side attracts people and enhances the value of the property in the neighborhood.

The first thing to be encouraged is the growth of a good sod from the edge of the traveled way to the fence line. Keep the weeds cut and give the grass a chance to grow. Where there are no trees, they should be planted. There is an opinion in the minds of many that trees harm a road, claiming that they retain the moisture and are in other ways baneful. Wherever the road is bad in the neighborhood of trees, the trouble is not with the trees but with the road. If the road were properly constructed and drained, the trees would cause no further trouble. In fact, with a macadam road, the moisture that would be held in the surface in the summer time would be a distinct advantage. In the winter time, if the low-hanging limbs are trimmed, there will be practically as much sun and wind come upon the road as though there were no trees, while their value in the summer time cannot be overestimated.

Trees along the road side should not be cut down at the caprice of an individual commissioner or even of the land owner alongside. Trees are a public asset and should be most jealously guarded and cut only

after due consideration by public officials who should be chosen for this purpose. These duties might be imposed upon existing public officials, but in any event, the wanton destruction of beautiful shade trees on the road side should be prevented. Care for the trees you have, it pays.

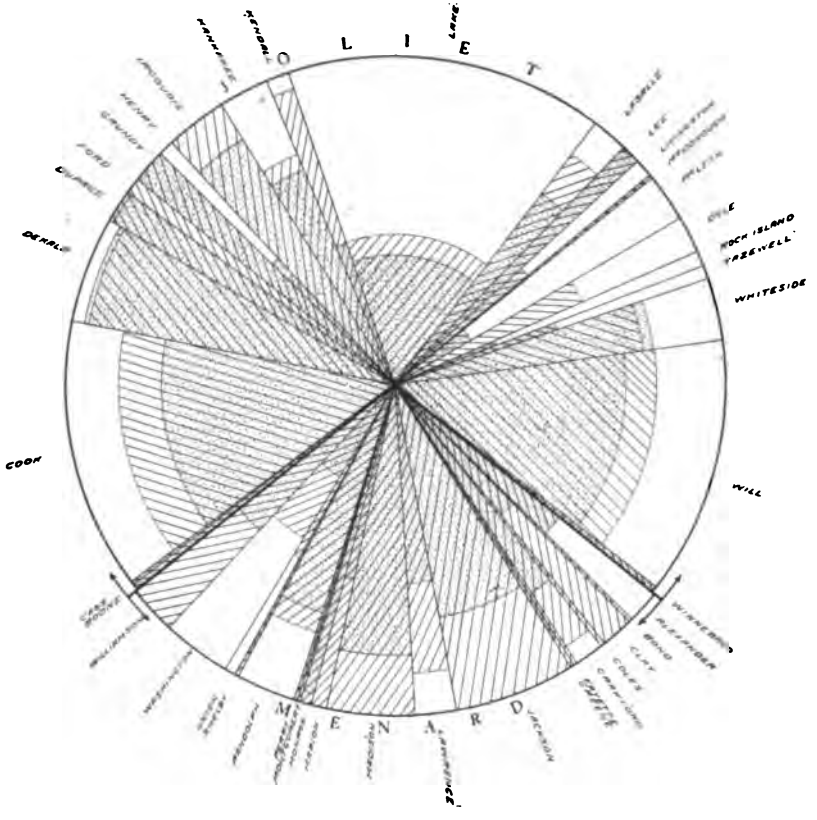


Fig. 43. Chart showing distribution of crushed stone from the penitentiaries during 1913.
Total area equals amount of application.
Hatched area equals amount of requisition.
Dotted area equals amount of shipments.

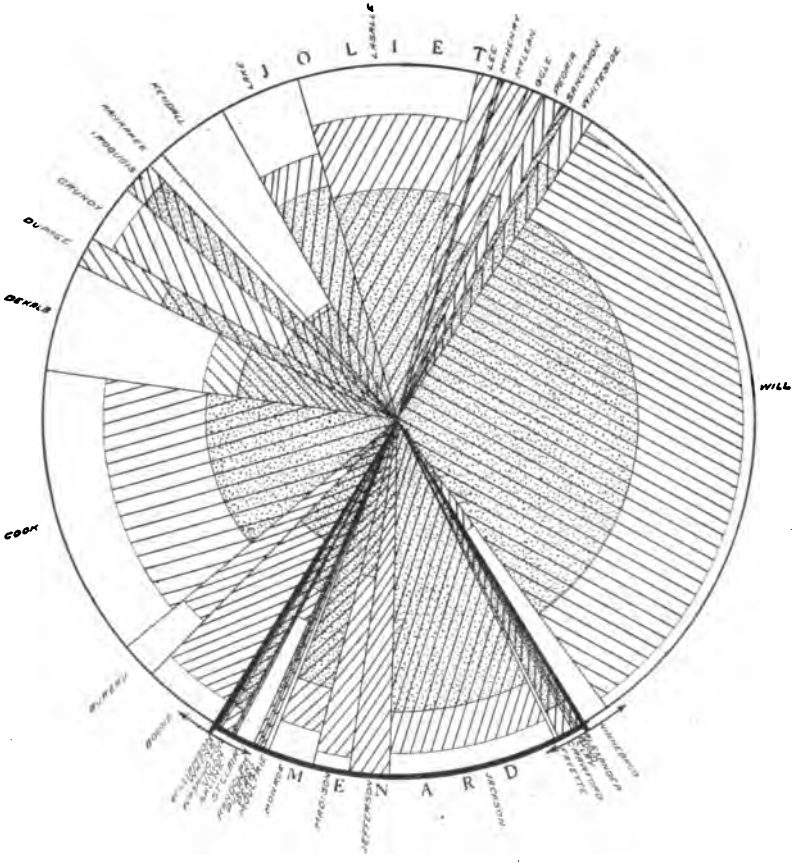


Fig. 44. Chart showing distribution of crushed stone from the State penitentiaries during 1914.
Total area equals amount of application.
Hatched area equals amount of requisition.
Dotted area equals amount of shipments.

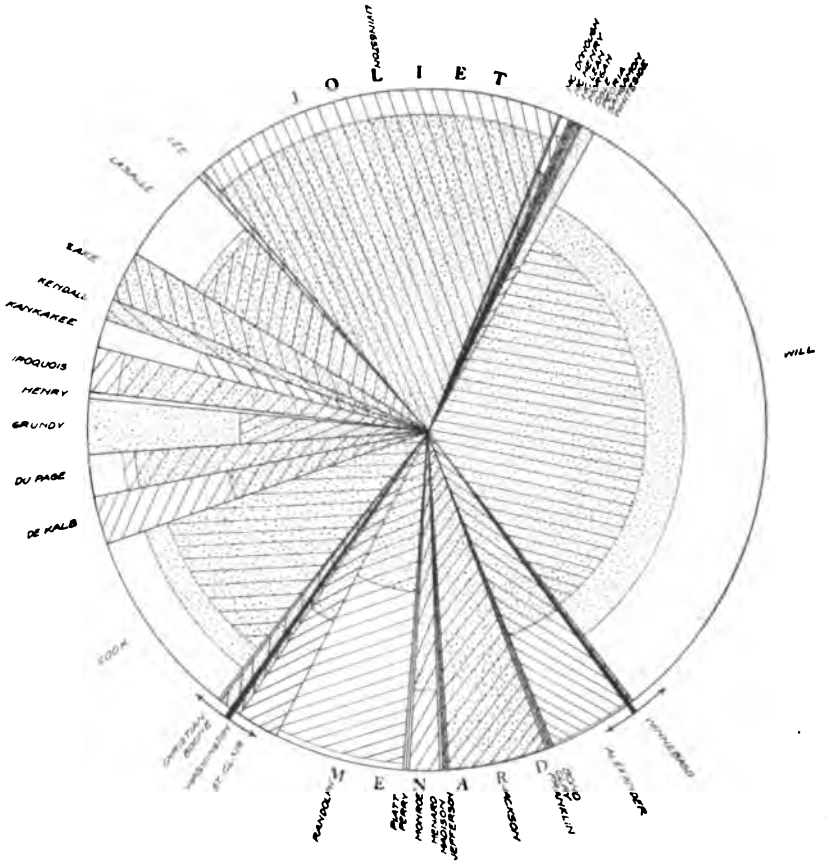


Fig. 45. Chart showing distribution of crushed stone from the State penitentiaries during 1915.
Total area equals amount of application.
Hatched area equals amount of requisition.
Dotted area equals amount of shipments.

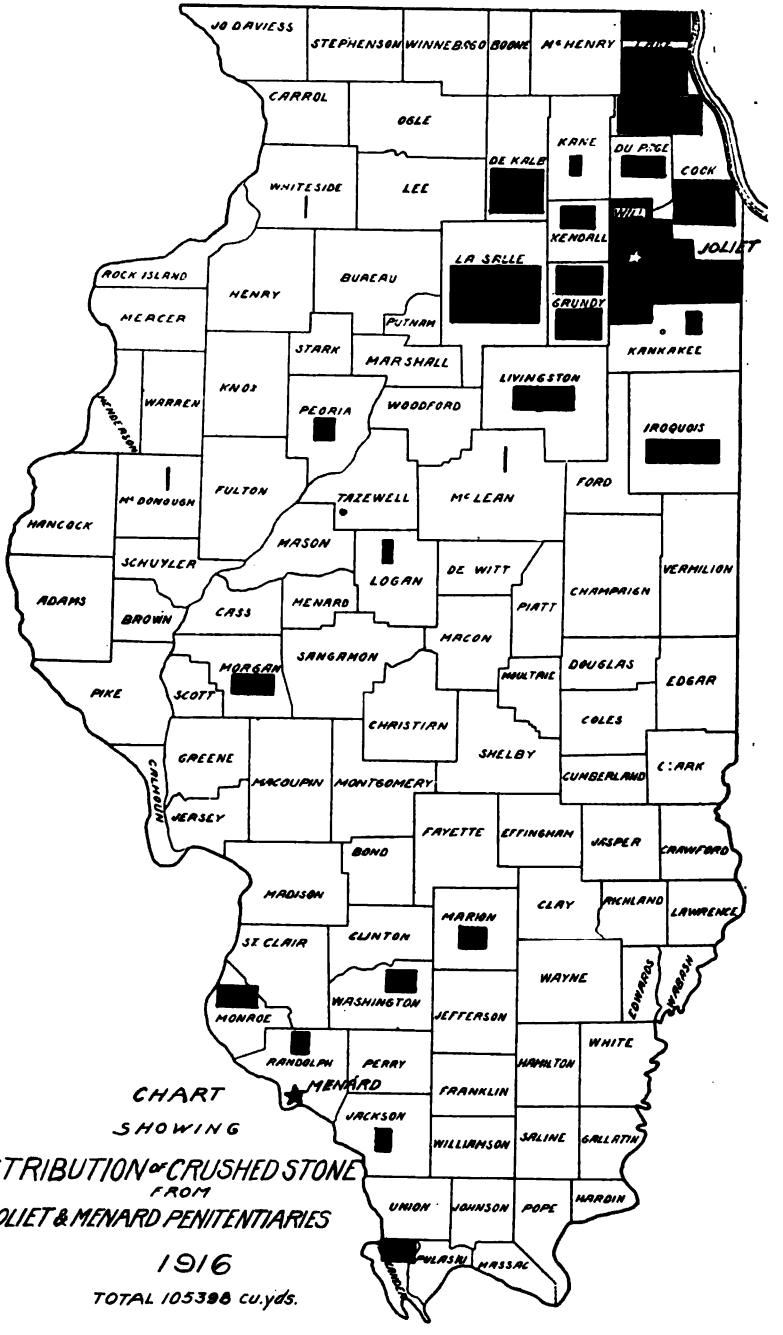

JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
McHENRY
CARROL
OGLE
KANE
DU PAGE
COOK
WHITESIDE
LEE
DE KALB
KENDALL
JOLIET
LA SALLE
ROCK ISLAND
HENRY
BUREAU
GRUNDY
MERCER
PUTNAM
KANKAKEE
STARK
MARSHALL
LIVINGSTON
KNOX
WARREN
PEORIA
WOODFORD
IROQUOIS
McDONOUGH
FULTON
TAZEWELL
McLEAN
FORD
HANCOCK
MASON
SCHUYLER
LOGAN
DE WITT
VERMILION
ADAMS
BROWN
CASS
MENARD
PIATT
CHAMPAIGN
MACON
SANGAMON
MORGAN
MOULTRIE
DOUGLAS
EDGAR
PIKE
SCOTT
CHRISTIAN
COLES
GREENE
SHELBY
CLARK
MACOUPIN
MONTGOMERY
CUMBERLAND
CALHOUN
JERSEY
FAYETTE
EFFINGHAM
JASPER
CRAWFORD
BOND
MADISON
CLAY
RICHLAND
LAWRENCE
MARION
ST CLAIR
CLINTON
WAYNE
EDWARDS
WABASH
WASHINGTON
MONROE
JEFFERSON
RANDOLPH
PERRY
HAMILTON
WHITE
MENARD
FRANKLIN
JACKSON
WILLIAMSON
SALINE
GALLATIN
UNION
JOHNSON
POPE
HARDIN
PULASKI
MASSAC
CHART
SHOWING
DISTRIBUTION of CRUSHED STONE
FROM
JOLIET & MENARD PENITENTIARIES
1916
TOTAL 105398 cu.yds.

Fig. 46.

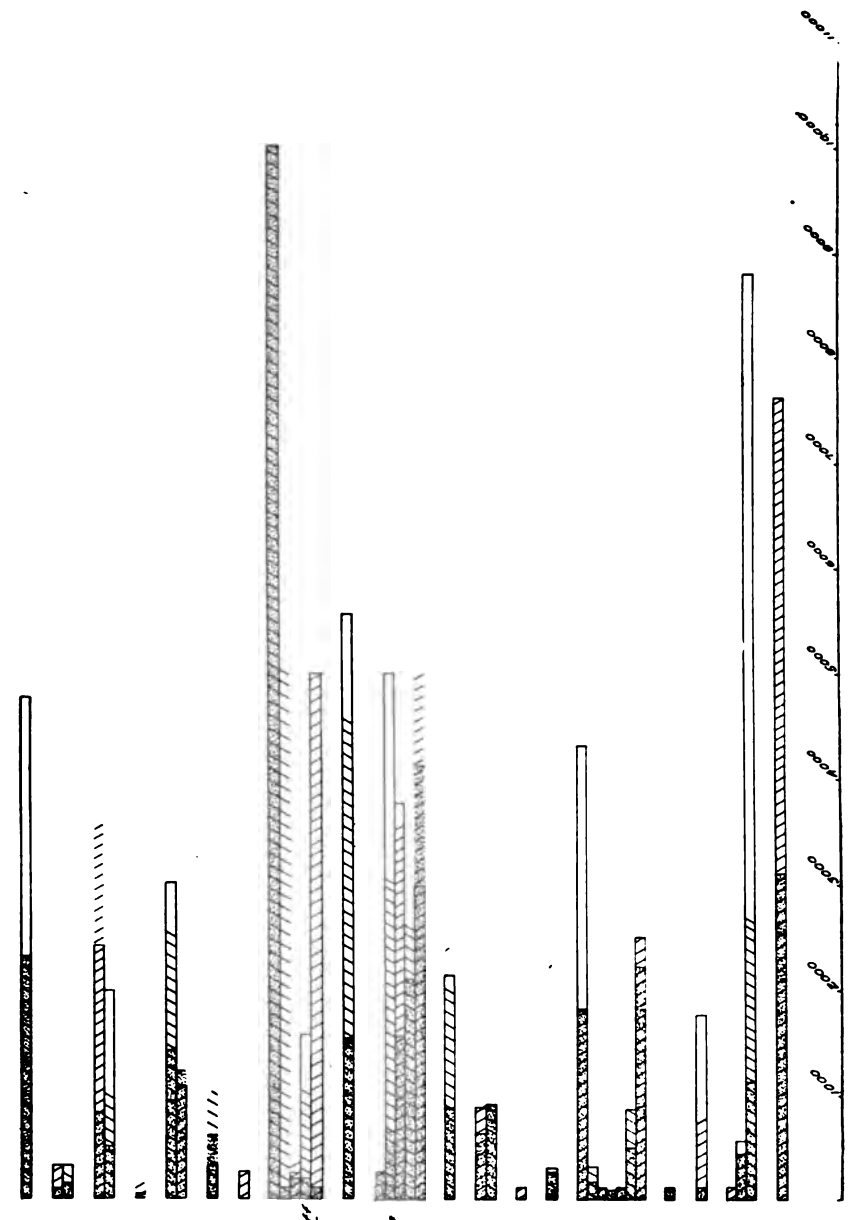
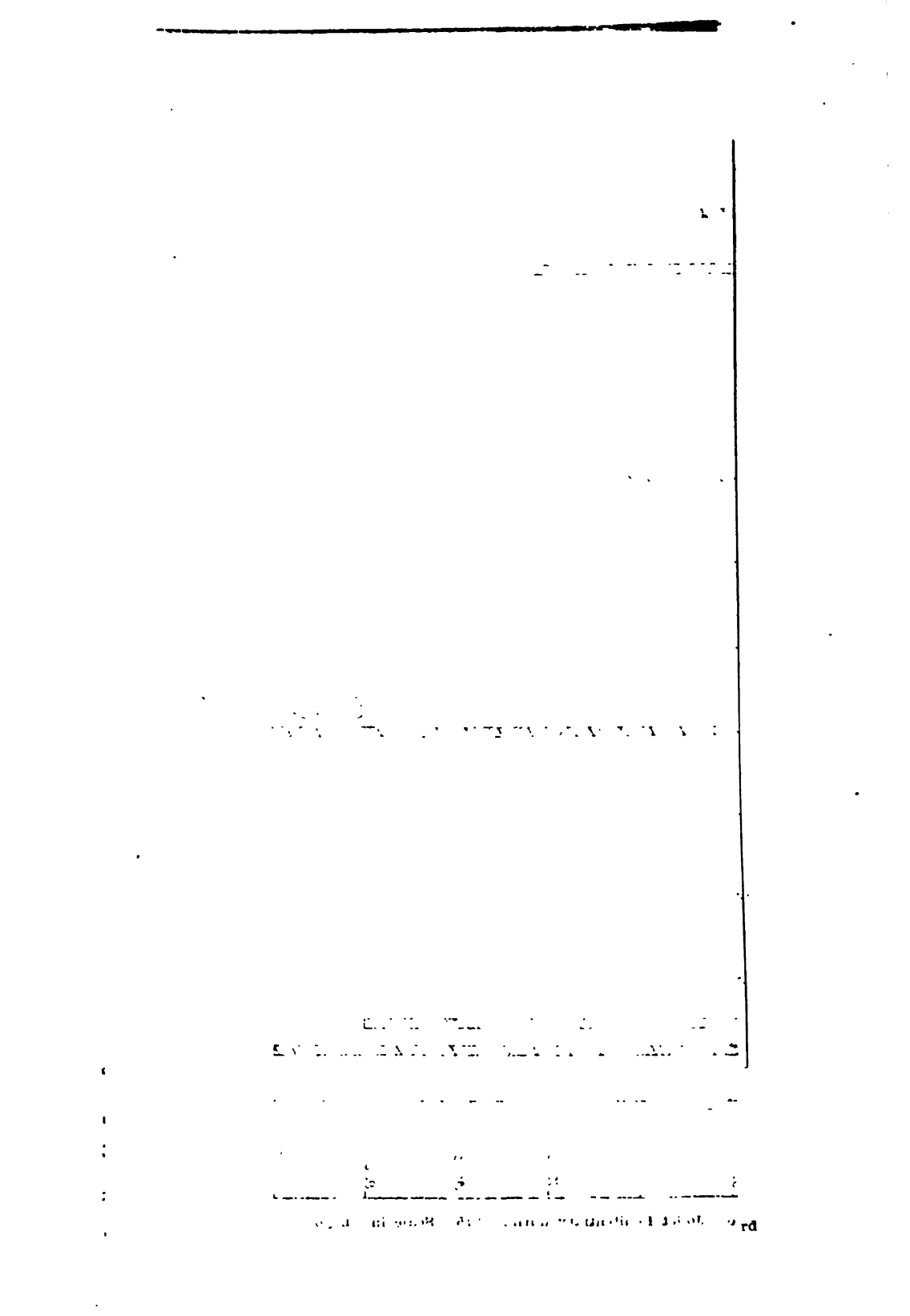
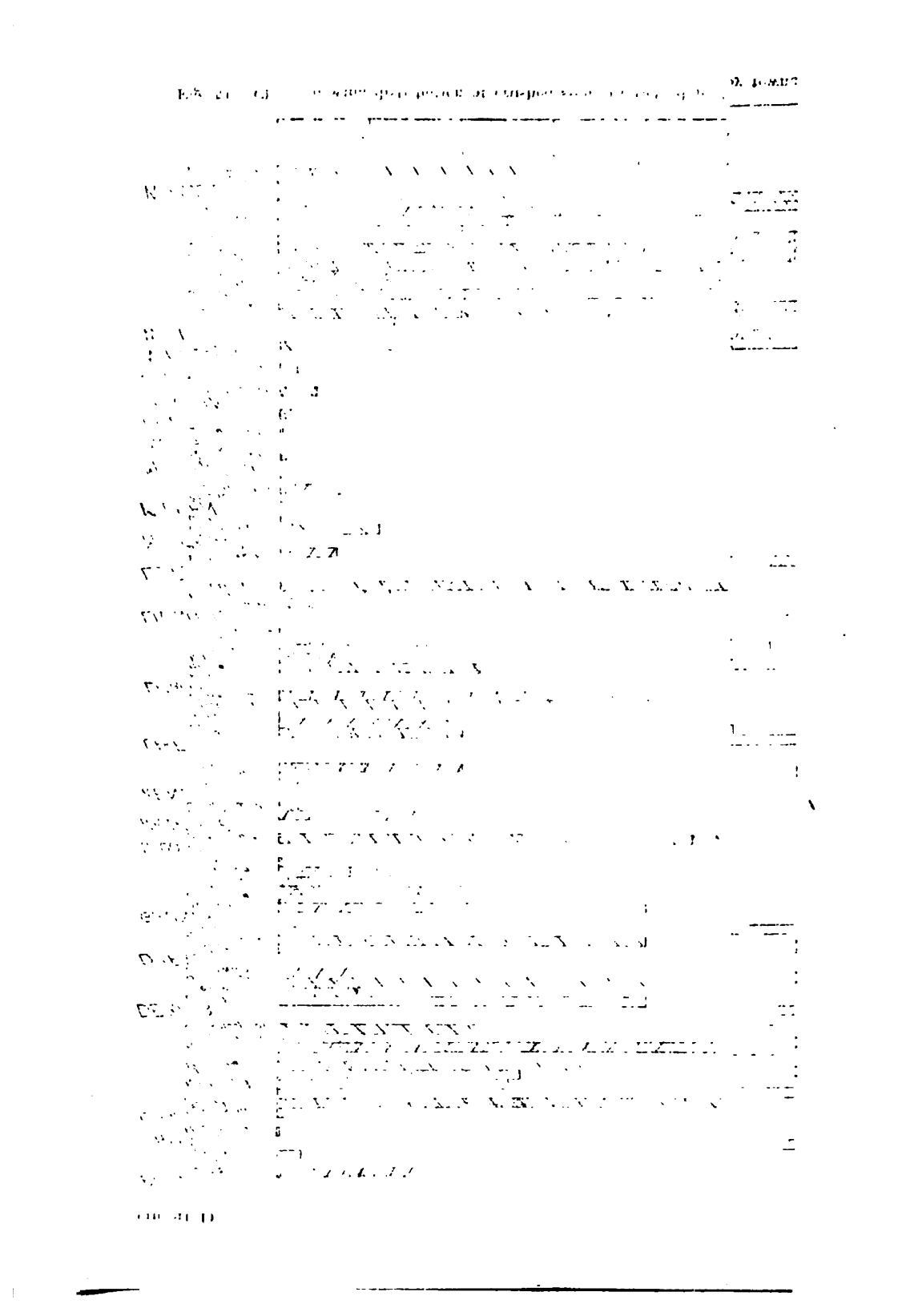


Fig. 48. Chart showing distribution of crushed stone by townships from Menard penitentiary during 1913. Scale in cu. yds.

Fig from Joliet Penitentiary, Jan'uy 1913. Scale in cu. yds.





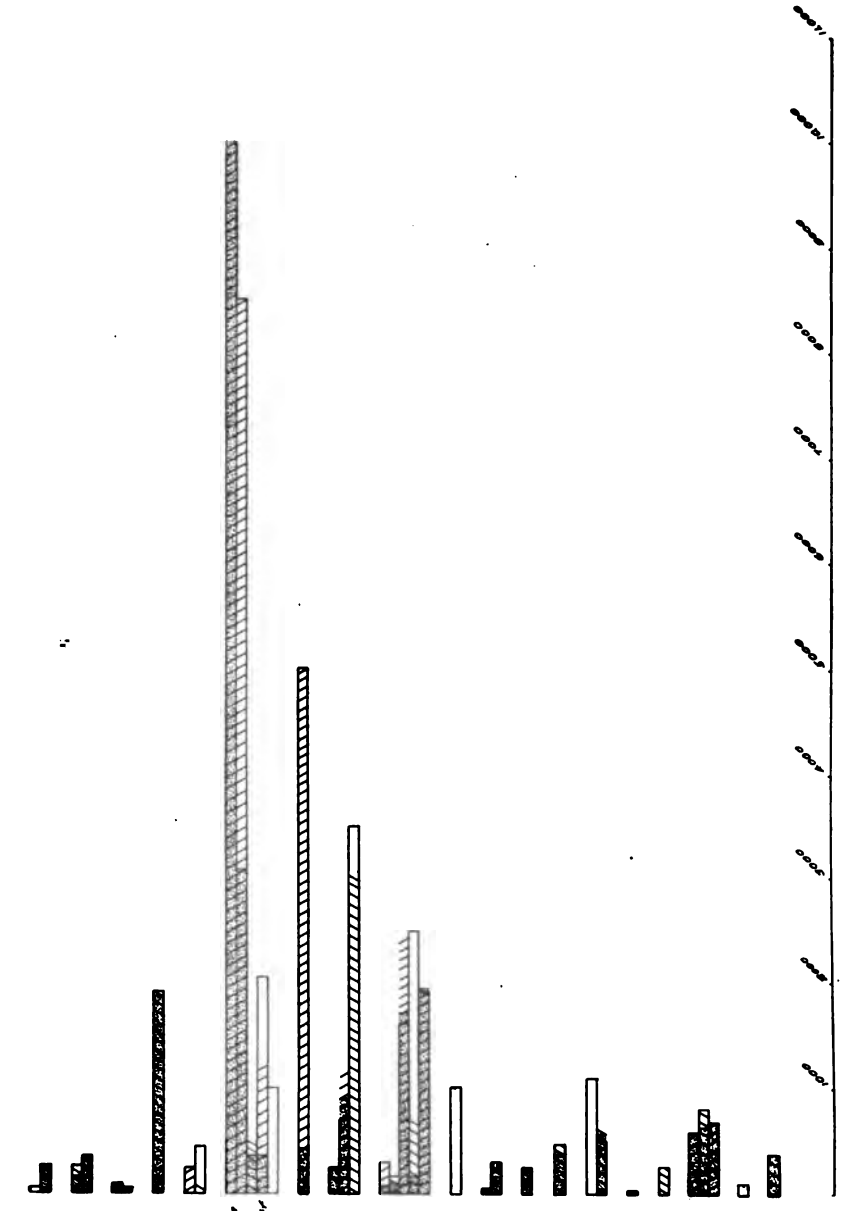


Fig. 50. Chart showing distribution of crushed stone by townships from Menard penitentiary during 1914. Scale in cu. yds.

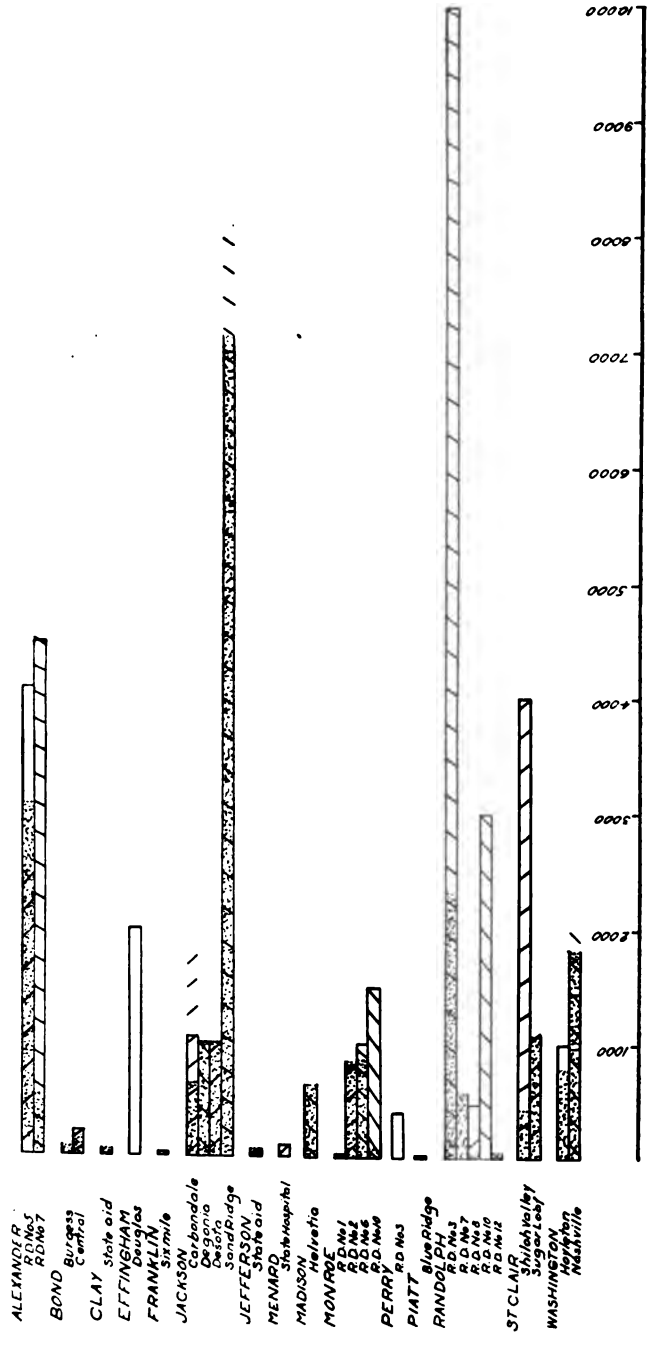


Fig. 52. Chart showing distribution of crushed stone by townships from Menard penitentiary during 1915. Scale in cu. yds.

TABLE XXIII—APPLICATIONS FOR CRUSHED STONE, 1916.

County.	Township.	Amount.
Grundy	Morris	3,965
Lake	Tremont	1,300
Woodford	Olio	100
Cook	Leyden	5,000
Cook	Rich	3,000
Cook	Bloom	2,000
Monroe	R. F. D. No. 8	400
Will	Joliet	10,000
Monroe	R. F. D. No. 6	600
Will	Channahon	300
Marion	Salem	875
Will	Custer	3,000
Cook	Orland	5,000
LaSalle	Ottawa	3,000
Clay	Clay City	45
Jackson	DeSoto	1,000
Jacksonville State Hospital		4,000
Jefferson	Shiloh	50
Monroe	R. F. D. No. 10	442
Monroe	R. F. D. No. 2	80
DeKalb	Pierce	480
DeKalb	..do	600
Randolph	R. F. D. No. 13	400
LaSalle	Bruce	2,500
LaSalle	Allen	3,000
Monroe	R. F. D. No. 8	200
Livingston	Pontiac	3,000
Lake	Vernon	2,500
Whiteside	Union Grove	80
Cook	Schaumburg	1,800
LaSalle	South Ottawa	1,000
LaSalle	Farm Ridge	3,000
LaSalle	Otter Creek	850
Iroquois	Beaver	200
Will	Reed	3,000
Grundy	Felix	3,000
Kane	Rutland	200
Monroe	R. F. D. No. 10	40
Monroe	..do	200
Lake	Shields	5,000
Lake	West Deerfield	3,000
Illinois State Park Commission		320
Iroquois	Stockland	600
Lake	Deerfield	4,500
LaSalle	Eden	300
Marion	Salem	325
LaSalle	Grand Rapids	1,000
Will	Manhattan	10,000
Illinois State Park Commission		240
Will	Joliet	3,000
Tazewell	Groveland	1,200
Will	Wilmington	1,000
Will	..do	1,000
LaSalle	Bruce	250
Kane	Plato	440
Lincoln State School & Colony		600
Randolph	R. F. D. No. 9	150
Ogle	Oregon	800
Alexander	R. F. D. No. 7	
LaSalle	Dayton	1,000
Will	Frankfort	3,000
DeKalb	Somonauk	2,000
Jackson	Fountain Bluff	1,000
Grundy	Braceville	2,900
Lake	Libertyville	1,200
Will	Troy	3,000
Grundy	Braceville	1,350
Will	Joliet	1,000
Randolph	R. F. D. No. 13	350
Iroquois	Middleport	2,500
DeKalb	Malta	40
Jackson	Kinkaid	700
Fayette	Vandalia	500
Kendall	Na-au-say	2,500
DeKalb	Pierce	390

TABLE XXIII—Concluded.

County.	Township.	Amount.
Will	Reed	3,000
McLean	Blue Mound	300
Grundy	Aux Sable	1,000
Total		131,662

TABLE XXIV—SHIPMENTS OF CRUSHED STONE FROM JOLIET PENITENTIARY IN 1916.

County.	Township.	Amount.	Total for county.
Cook	Barrington	444	
Cook	Bloom	2,969	
Cook	Bremen	2,022	
Cook	Leyden	3,020	
Cook	Orland	2,470	
Cook	Palatine	1,888	
Cook	Rich	1,168	
Cook	Schaumburg	145	14,126
DeKalb	DeKalb	258	
DeKalb	Malta	33	
DeKalb	Pierce	545	
DeKalb	Somonauk	3,908	
DeKalb	Victor	966	5,710
DuPage	Addison	662.5	
DuPage	Downers Grove	1,104	
DuPage	Naperville	258	2,024.5
Grundy	Aux Sable	902	
Grundy	Felix	1,492	
Grundy	Greenfield	824	
Grundy	Morris	3,743	6,961
Iroquois	Middleport	3,691	
Iroquois	Stockland	512	4,203
Kane	Plato	426	426
Kankakee	Yellowhead	366	366
Kendall	Na-au-say	360	
Kendall	Seward	1,372	1,732
Lake	Cuba	1,061	
Lake	Ela	1,098	
Lake	Tremont	1,305	
Lake	Libertyville	1,218	
Lake	Shields	4,982	
Lake	Vernon	2,494	
Lake	West Deerfield	1,189.5	13,347.5
LaSalle	Allen	805	
LaSalle	Bruce	1,764	
LaSalle	Dayton	835	
LaSalle	Eden	310	
LaSalle	Farm Ridge	1,572	
LaSalle	Grand Rapids	210	
LaSalle	Ottawa	2,532	
LaSalle	Otter Creek	819	
LaSalle	South Ottawa	1,008	9,855
Livingston	Pontiac	2,504	
Livingston	Reading	840	3,344
Logan	Lincoln	108	108
Whiteside	Mt. Pleasant	84	84
Will	Channahon	46	
Will	Creste	1,500	
Will	Custer	672	
Will	Florence	1,944	
Will	Frankfort	2,638	
Will	Homer	613	
Will	Joliet	4,864.5	
Will	Lockport	1,375	
Will	Manhattan	335	
Will	New Lenox	988	
Will	Plainfield	168	
Will	Reed	2,953	
Will	Troy	1,270	
Will	Wilmington	1,980	
Will	Wilton	589	21,935.5

TABLE XXIV—Concluded.

County.	Township.	Amount.	Total for county.
Institutions—			
Macomb		99	
Illinois State Park Commission		3,042	
Illinois State Park Commission		301	
Illinois State Park Commission		225	
Peoria State Hospital		876	
Normal		117	
Honor Farm, I. S. P.		4,544 5	
Chicago State Hospital		65	
Jacksonville State Hospital		2,220	
Kankakee State Hospital		378	
Lincoln State School and Colony		450	12,317. 5
Total		96,540. 0	96,540. 0

TABLE XXV—SHIPMENTS OF CRUSHED STONE FROM MENARD PENITENTIARY IN 1916.

County.	Township.	Amount.	Total for county.
Alexander	R. F. D. No. 7	1,857	1,857
Jackson	Fountain Bluff	666	
Jackson	Sand Ridge	166	832
Marion	Salem	1,176	1,176
Monroe	R. F. D. No. 1	32	
Monroe	R. F. D. No. 6	256	
Monroe	R. F. D. No. 10	1,985	2,273
Randolph	R. F. D. No. 3	820	
Randolph	R. F. D. No. 7	75	
Randolph	R. F. D. No. 10	67	
Randolph	R. F. D. No. 13	32	994
Washington	Hoyleton	42	
Washington	Nashville	1,684	1,726
Total			8,858

TABLE XXVI—SHIPMENTS OF CRUSHED STONE BY MONTHS, 1916.

Month.	Joliet.	Menard.	Total.
January	465	1,186	1,651
February		1,332	1,332
March	9,167	1,733	10,900
April	15,398	1,499	16,897
May	16,205	215	16,420
June	10,261. 5	971	11,232. 5
July	9,654	358	10,012
August	11,571	444	12,015
September	9,721	232	9,953
October	6,308. 5	314	6 622. 5
November	5,455. 5	242	5,697. 5
December	2,333. 5	332	2,665. 5
Total	96,540	8,858	105,398

PART IV

Bureau of Tests

REPORT OF BUREAU OF TESTS.

(F. L. ROMAN, Testing Engineer.)

The work of the testing laboratory of the State Highway Department has increased very rapidly in the past years, the amount of routine testing comprising the examination and analysis of road and bridge materials to determine if they comply with the requirements of the specifications, being approximately six times what it was three years ago. Considerable experimental work has also been undertaken in connection with the preparation of specifications and the investigation of new materials and new methods of testing.

The removal of the laboratory to suitable quarters at 820 East Adams Street, Springfield, and the reorganization of the department with the appointment of bureau chiefs have greatly increased the efficiency of the laboratory. For several years the laboratory was located in the State Arsenal at Springfield, and owing to lack of space the testing had to be undertaken under many difficulties. Because of the large increase in testing work and the impossibility of securing the required space in the State buildings, it was found that the only means of remedying the unsatisfactory conditions in the laboratory was to lease suitable quarters in Springfield. The laboratory was therefore removed to its present location in November, 1915. Considerable difficulties were encountered in the removal of the equipment owing to the necessity of delaying as little as possible the examination and analysis of the samples submitted at that time, but on December 31, 1915, the laboratory was working under better conditions than it had at any time since it had been established.

The reorganization of the State Highway Department during 1915 has done much to simplify the laboratory work in many respects, especially in the handling of correspondence and of all data and records of tests of road and bridge materials. The division of the department into bureaus having each a well defined field of activity has also permitted to systematize better the work of the laboratory and by preventing conflict of authority to perform all testing under much more satisfactory conditions. This has resulted in a better enforcement of the specifications and consequently in the use of more uniform materials of construction.

During 1913, the State Highway Department was passing through a period of reorganization, to meet the requirements of the new road

law enacted by the Legislature in the spring of the same year. The amount of actual construction work undertaken, and the amount of routine testing carried on in connection with construction work were relatively small.

Two hundred and eighty-nine samples of various materials were received. Of these 36 were asphalts, tars or road oils; 22 cements, 9 paints, 111 rocks, sands and gravels, 4 creosotes and 7 miscellaneous materials.

In 1914, the amount of construction work was much greater than in past years, and the work of the laboratory was also largely increased. One thousand six hundred and sixty-three samples of various materials were received. Of these 1,130 were cements, 132 sands, 133 gravels, 130 rocks, 62 paving bricks, 24 asphalts, 15 paints, 15 road oils, 7 waters and 15 miscellaneous materials.

In 1915, one thousand, eight hundred and six samples of various materials were received. Of this number 1,198 were cements, 229 sands or gravels, 104 paving bricks, 116 asphalts and road oils, 29 paints and linseed oils, 28 rocks, 102 miscellaneous materials comprising tars, steels, paints, creosotes, etc.

In 1916, one thousand, seven hundred and five samples were received. This number consisted of 765 cements, 260 samples of paving bricks, 240 sands and gravels, 44 samples of rocks, 36 samples of crushed stone or screenings, 175 road oils, 37 asphalts, 54 paints and linseed oils, and 94 samples of miscellaneous materials, including tars, expansion joints, bituminous concrete, bituminous concrete fillers, emulsions, creosotes and creosoted blocks and lumber, concrete hardeners and waterproofing compounds, waters, slags, clays, and steels. This does not include numerous samples of materials prepared in the laboratory for experimental purposes.

EQUIPMENT.

The large increase in laboratory work in 1914 and 1915 necessitated the purchase of some important additional equipment. Up to 1913, the materials tested in the laboratory were mainly tars, asphalts, sands and gravels, with occasional samples of paints, creosotes and cements. The building of concrete and brick roads on a large scale in 1914, brought up the necessity of testing a large number of samples of stones, bricks and cements, and preparation was made to take care of this new demand. The most important equipment added to the laboratory consists of a brick rattler; an abrasion machine for rocks; a toughness machine for rocks with core drill, diamond saw and grinding lap; a ball mill, briquette forming machine and a cementation value machine for rocks; a cement testing machine with moulds; a moist closet and a set of tanks for briquettes, and a centrifuge for paints.

At present, the laboratory is properly equipped to test road oils, tars, asphalts and other bituminous materials, creosotes and creosoted blocks and lumber, paints, cements, sands, gravels and bricks. A hardness machine is needed to complete the equipment for testing rocks, and

a Universal Testing Machine of high capacity should also be purchased for the testing of concrete and steel.

CEMENTS.

The contract to furnish the cement for State aid road work during the summer of 1914 having been awarded to the Marquette Cement Manufacturing Company, arrangements were made to provide for the testing of some 200,000 barrels of cement. Because of the necessity of testing a large number of cars in a short length of time and at short notice, it was found advisable to test all the cement at the plant even though this would require some extra expenses in laboratory supplies and labor. The Marquette Cement Manufacturing Company agreed to furnish two suitable rooms for testing purposes. These rooms were provided with our own locks and with the necessary equipment.

The laboratory work started July 15 and ended December 15, 1914, during which time a total of 1,064 cars were tested. Every car was subjected to the usual physical tests for soundness and strength, while 754 cars were subjected to chemical tests. In testing, the following procedure was followed:

One sample from every tenth barrel was taken from the loaded cars. The cars were then sealed, but were not shipped until the cement had been accepted. When a car of cement was found to be satisfactory, cards were sent to the contractor, resident engineer and division engineer, who had supervision over the work for which the cement was intended, advising them that the cement in a given car, with given car seals had been tested and found satisfactory. When a car of cement was found to be unsatisfactory, it was rejected at the plant, and all the cement was to be accepted before it was shipped.

Each sample obtained from every tenth barrel was tested for soundness by making pats and subjecting them to the usual steaming test. The remaining samples from every tenth barrel in one car were then mixed together and neat and sand briquettes were prepared to determine the average strength of the cement in the car. Fineness and specific gravity tests were also undertaken at intervals.

At the beginning of the season, chemical tests for sulphuric anhydride were made on approximately one car out of every twenty. Two hundred and thirty cars were tested in this manner, but it was found that the cement which was accepted on the physical tests was not always entirely satisfactory from a chemical standpoint. The Marquette Cement Manufacturing Company then agreed to furnish all cement to meet the specifications of the U. S. Bureau of Standards, which require specific chemical tests. A chemist was immediately sent to the plant at LaSalle and as soon as properly equipped, tested every car for sulphuric anhydride, loss on ignition and insoluble residue. Every car from No. 358 to 1064 was subjected to these tests. The chemical testing of cement on such a scale is very unusual and increased a great deal the cost of testing the cement. The cost per barrel was $0.0116.

Contracts to furnish the cement for State aid road work during 1915 were awarded to several companies. Approximately two-thirds of

this cement was tested at the mills at LaSalle by employees of the State Highway Department, while the remaining cement was furnished by six companies and tested at their mills by private testing laboratories. The work at LaSalle started April 6 and was completed December 12, the total amount of cement tested consisting of 152,274½ barrels shipped in 738 carload lots. Of this amount 724 cars containing 149,870½ barrels were tested at the mills of the Marquette Cement Manufacturing Company, and 14 cars containing 2,404 barrels were tested at the mills of the Chicago Portland Cement Company. The cement was tested in the same manner as in 1914, samples from each car being submitted to both physical and chemical tests. The total cost of testing was approximately 1.3 cents per barrel, including all expenses at the mills, trips of inspection to the mills and cost of supervision as closely as could be estimated.

A large portion of the cement tested by the private testing laboratories was inspected at the contract price of 3 cents per barrel. As there was a large amount of clerical work in the laboratory at Springfield in connection with this testing and it was necessary to retest some of this cement, the total cost of inspection was therefore somewhat larger than would be indicated by the contract price of 3 cents per barrel.

A number of samples of cement were also tested in the laboratory at Springfield. These samples were partly check samples from the mills at LaSalle, and partly samples of miscellaneous brands.

Contracts for the furnishing of Portland Cement on State aid roads in 1916 were awarded to eight companies. This number did not include one company which shipped cement to some work which had been started in 1915, and cement was therefore furnished to the State from mills operated by nine different companies. As the amount furnished by some of the mills was relatively small, it was thought advisable to test all the cement at Springfield, Illinois. The samples were taken from the loaded cars at the mills from every tenth barrel in the usual manner, and shipped immediately in closed containers to the laboratory at Springfield. Robert W. Hunt & Co., were awarded the contract for sampling this cement at the mills of seven of the companies. Because of labor troubles two campanies with mills at LaSalle were unable to make any shipments during a large portion of the construction season. When shipments were started again in the fall, arrangements were made to have a local cement tester sample the cement at these two mills and forward the samples to the laboratory at Springfield.

The results of tests of cement and other materials used in State aid construction during the past three years would seem to indicate that a much larger per cent of defective concrete is due to unsatisfactory sand, gravel or stone, poor workmanship, improper mixing and curing, than to cement of poor quality. They show however the necessity of testing cement not only for large enterprises, but also for small jobs. As the cement for large enterprises is generally tested, the cement which does not come up to standard is likely to be shipped for use on small jobs where it has been found that the engineer in charge of the work often lacks the time necessary to have the proper tests performed. Under these conditions a simple preliminary test of the cement can however generally be made by the engineer in the field. While this test does not show

if a cement is of standard quality, it will at least show if a cement is sound and sets properly. The directions given below for performing this test were printed in the spring of 1914 for the use of engineers in the field:

Steam Test for Cement.—The object of this test is to develop in a short time the defects which tend to destroy the strength and durability of cement.

The steaming test consists of making pats of cement paste, keeping these pats in moist air for 24 hours, and then exposing them to steam above boiling water for 5 hours. Failure of the pats is revealed by checking, cracking, curving, swelling or desintegration.

Method of Testing.—Prepare a paste of cement not too dry nor too wet. Try adding various quantities of water until a good paste is obtained. A paste of cement is of the correct consistency when it is such that if a ball of the paste is dropped upon a hard surface from a height of 2 feet, it will not crack nor flatten to more than half of its original thickness. A cement generally requires from 20 to 25 per cent of water by weight to prepare this paste. The paste is then made into pats on plates of glass (pieces of glass 4 inch by 4 inch and ⅛ inch thick are recommended). The pats should be about 3 inches in diameter, one-half inch thick at the center and tapered to a thin edge.

The pats are stored in moist air for 24 hours. To store these pats take a bucket or a large dish containing a little water. Place drinking glasses or supports of some kind in the water and arrange the glasses with the pats on these supports, taking care that the water does not touch the pats. Keep a moist towel on the dish or bucket but do not allow the towel to touch the pats. Store the pats for 24 hours, keeping the towels moist all the time. If the cement sets properly, the pats should not be hard one hour after the cement paste was prepared, and a pencil point should penetrate readily in the pat. After 24 hours the pats are placed in some boiler, dish or bucket, in which water may be boiled. The pats are arranged on supports in a manner such that they will not touch the water but will be surrounded by steam. Do not use a tight lid or cover on the boiling vessel, but cover loosely in such a way that the steam will not be under pressure. A towel over the dish will do if nothing better is available.

After boiling 5 hours, examine the pats. The cracks usually appear first on the thin edges. Note if there is any apparent change in the volume and shape of the pats, such as curling away from the glass. The pats may leave the glass during the steaming process, and this is no cause for rejection of the cement, provided the pats do not curl. When broken the pats should feel hard and should not crumble readily.

NOTE.—When selecting samples of cement, take small quantities from a number of sacks or barrels at random. Do not take samples only from the surface of the sack, as such a sample might not represent a fair average.

For laboratory testing, send ten (10) pounds of cement in good, clean, canvas bags, or better in a sealed tin can. It is preferable, however, especially when in doubt as to the quality of only a portion of the shipment, to take approximately 20 samples of at least one-fourth

pound each from a number of sacks at random, and keeping these individual samples in separate packages to ship them properly packed in a tight box to the laboratory.

BITUMINOUS MATERIALS.

The tests of road oils, asphalts, and tars examined during 1913, 1914, 1915, and 1916 are given in Tables I to IX inclusive. The tests of bituminous expansion points tested in 1916 are given in Table X.

A large per cent of the road oils were tested at the request of township officials, and there has been a large number of demands for information as to quality, prices, specifications, methods of application, etc., of these oils. It was thought advisable to prepare a publication which would contain data and suggestions concerning road oils and their use, and Bulletin No. 6 was issued. Because of their low cost most of the oils used on earth roads in this State during the past year have been Illinois, Kansas or Oklahoma products. While these oils have practically none of the binding qualities of the asphaltic oils, they have tended to waterproof the roads and also to prevent the formation of dust. When applied properly they have prevented the dust nuisance in summer and have maintained the roads in good condition in fall and early winter. The oiled earth roads did not appear to be capable to withstand hard winters and it has been necessary to regrade these roads in spring and to oil them at least once or twice every year. Light asphaltic and semi-asphaltic oils with good binding qualities appear to have given the best results in surface oiling and it is probable that the asphaltic oils do not have to be applied as often as do the paraffin oils to keep a road in satisfactory condition. Owing to their somewhat higher cost the asphaltic oils have not been applied on earth roads to any large extent in this State and the cheapest grades of paraffin oils have been by far the most popular. The belief that any cheap oil is good enough to lay the dust has been found, however, to be entirely erroneous, and the State Highway Department has received several reports of failures of oiled earth roads due to the use of unsuitable products. Too light an oil cannot prevent the formation of dust, and the light oily dust resulting will not settle readily under rain; while too heavy an oil will tend to pick up in patches. Even with the best products, however, it is always advisable to oil the road when it is practically free from dust and loose material.

The number of asphalt and tar roads built under State supervision was relatively small, but a number of macadam and gravel roads were treated with heavy asphaltic oils. These oils were all viscous products at ordinary temperature, and were applied hot.

BRICKS.

The tests of paving bricks are given in Tables XI, XII, and XIII. A number of the tests tabulated were made on the worst blocks in the lot to guide in the culling of the brick.

It was noted that most of the bricks which failed to pass the rattler test were either underburnt or showed marked laminations, and that

wide variations in the wearing qualities of individual bricks could be largely eliminated by their proper grading when they were removed from the kilns. The State Highway Department has laid a great deal of stress on uniformity of wear in bricks, and the specifications have been modified so as to permit the use of somewhat softer bricks which show exceptionally uniform wearing qualities for individual bricks.

ROCKS.

The rocks tested during 1913, 1914 and 1915 have been mainly limestones and dolomites. Tables XIV, XV, and XVI show the physical properties of these rocks. Their specific gravity varied from 2.48 to 2.82 giving as weights per cubic foot values varying from 155 pounds to 176 pounds. The minimum absorption per cubic foot was 0.17 pounds and the maximum absorption 10.1 pounds. In wearing qualities the rocks have shown per cents of wear varying from 2.5 to 15.9 while their toughness varied from 5 to 18.

It should be noted, however, that the samples received were not always fair samples of the average rock in the quarry. The quality of the rock in the quarries usually varies a good deal with the depth of the layer, and it is often difficult to obtain a sample representing the averare material. The samples submitted by stone companies represented in general, rock of better quality than the average material furnished by these companies, although samples have been received which were taken from top layers and which represented practically the worst material in the quarry. It would appear from the difficulties encountered during the past years, that the only way of obtaining fairly accurate comparative data on the quality of the rocks from the various stone quarries, would be to select a number of samples from the different layers in each quarry, and by taking into account the individual results of tests and the surface of rock represented by each sample to calculate the values which the average material will give when tested. Sampling and preparation of sample as well as the testing should be done under identical conditions.

It had been hoped that this work could be carried on by this laboratory during the past years, but the rather large cost of such an undertaking has made it necessary to postpone it until sufficient money can be provided for this purpose.

SANDS AND GRAVELS.

A large number of sands and gravels have been tested during 1914, 1915 and 1916, mainly as to their suitability for use in concrete roads. The tests of the sands and gravels received in 1914, 1915 and 1916 are given in Tables XVII, XVIII and XIX.

The sands were subjected to a sieve analysis and to an examination of their clay and organic loam content. Mortars of 1 part of a Portland cement of good quality and 3 parts of the sands were prepared and the tensile strength of the briquettes obtained compared to the strength of briquettes prepared with Standard Ottawa sand and the same cement

under identical conditions. In general, bank sands gave mortars of better strength than river sands, and limestone sands gave mortars of better strength than silica sands, but the best mortars prepared, combining both strength and fair hardness of the sand grains, were obtained with sands composed of mixed materials. Excess of very fine material in the sand, or the presence of organic loam even in very small amounts have always been noted in connection with mortars of poor strength. Small amounts of clay have caused no decrease in the tensile strength of the mortars, and appeared to be rather beneficial. Large quantities of clay, however, have caused a decrease in the tensile strength of the mortars. The above conclusions have been checked by about 300 tests with sands to which various quantities of clay or loam had been added.

It should be noted, however, that in all tests given above, fairly dry mortars were prepared, and that in the rather wet mortars commonly used in practice, even small quantities of clay may cause trouble. In wet mortars, clay will flush to the surface with the water, and cases have been met in practice in which layers of clay were apparent in the concrete, and each batch of concrete in the structure was separated from the next one by bands of laitance and mud seams. Even in small quantities, clay is also harmful when it appears in lumps, and tests have also invariably shown that small quantities of clay which would cause no decrease in the strength of the mortar when present as dust in the sand, will cause a large decrease in strength when the clay coats the sand grains.

Gravels were subjected to a sieve analysis, and were examined for hardness. With unscreened gravels, the sands were screened out and tested also for their mortar making properties and clay or organic loam content. A number of road gravels were received, and the samples tested in 1914 and 1916 are given in Tables XX and XXI.

MISCELLANEOUS TESTING.

The routine testing of the laboratory during the past years comprised also the examination and analysis of paints for steel bridges, waters for concrete, creosotes and creosoted lumber, and miscellaneous products. The tests of paints are given in Tables XXII, XXIII, XXIV, and XXV.

It is impossible to give an estimate of the value of laboratory inspection during the past years, as a large number of the samples of unsatisfactory materials were tested to determine if they were suitable for a given type of construction before any of the materials were furnished on the job. It may be stated, however, that the materials furnished for highway work and which were rejected during 1914 and 1915 because they failed to meet the requirements of the specifications had a value, at the purchase prices of these materials, of at least fifty thousand dollars. Had there been no inspection it is probable that the proportion of products furnished which would have failed to meet the requirements of the specifications would have been much greater.

A constant effort has been made to test all products and to reply to all inquiries in the shortest time possible, but owing to the badly crowded

condition of the laboratory in the past, there have been some unavoidable delays. The better facilities which were provided during the fall of 1915 have made it possible to test the samples received in 1916 in general very promptly. It should be remembered, however, that some tests require several days, and that when samples are submitted to the laboratory a reasonable allowance for the time required in testing should be made.

TABLE I—TESTS OF

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25°}{25°}$ C.	Flash point in °C.	Burning point in °C.
606	Dustnoil	National Refining Co., Cleveland, Ohio.	John Miller, Galva, Ill	0.892	95	112
613	Not given	Not given	A. R. Keeler, Altona, Ill	0.902	145	158
616	Not given	..do	S. P. Mitchell, Oneida, Ill	0.897	98	115
628	Not given, No. 1	..do	Chas. Schlettinger, Highland, Ill.	0.921	165	177
618	Not given	..do	H. A. Shield, Greenfield, Ill	0.896	117	132
629	Not given, No. 2	..do	C. Schlettinger, Highland, Ill	0.925	157	185
638	Not given	National Refining Co., Cleveland, Ohio.	C. W. Bird, Minier, Ill	0.880	73	106
639	Standard asphalt road oil No. 4.	Standard Oil Co	..do	1.014	187	208
640	Not given, No. 3	Not given	..do	0.903	164	182
652	Not given	..do	J. H. Butler, Hartsburg, Ill	0.920	144	173
660	Not given	..do	G. Dixon, Stronghurst, Ill	0.892	....	....
662	Not given, No. 2	..do	H. B. Griffiths, Bowen, Ill	0.905	157	178
664	Not given, No. 1	..do	..do	0.912	182	203
665	Not given, No. 3	..do	..do	0.989	181	203
766	Not given	..do	C. E. Kelly, Brimfield, Ill	0.910	....	....

TABLE II—TESTS OF

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25°}{25°}$ C.	Flash point in °C.	Burning point in °C.	Specific viscosity $\frac{50°}{25°}$ C.
1108	Besco Bonding Paint	Bituminous Products Co., Detroit, Mich.	Bituminous Products Co., Detroit, Mich.	.838	*25	**	7.1
1134	80-90 California Road Oil.	.....	G. W. Lamson, Railway Exchange Building Chicago, Ill.	.962	185	225	5
1135	Bituminous Material H. O.	Sun Co., Morris Building, Philadelphia, Pa.	Sun Co., Philadelphia, Pa.	.999	218	251	.....
1137	Astec H. O.	U. S. Asphalt Refining Co., New York, N. Y.	U. S. Asphalt Refining Co., New York, N. Y.	1.028	215	255	.....
1139	Astec Liquid Asphalt	..do	..do	.942	32	50	15.5
1140	Standard Asphalt Road Oil No. 6.	Standard Oil Co	W. H. Meyers, Room 926, 72 West Adams, Chicago, Ill.	.948	158	175	70.0
1150	Trinidad Liquid Asphalt "A".	Barber Asphalt Paving Co., 2532 S. Paulina St., Chicago, Ill.	Barber Asphalt Paving Co., 2532 S. Paulina St., Chicago, Ill.	.965	60	75	19.1
1151	Trinidad Liquid Asphalt "B".	..do	..do	.983	120	140	102
1164	Trinidad "A"	..do	N. J. Maurer, 2532 S. Paulina St., Chicago, Ill.	.962	52	65	15.9
1165	Trinidad "B"	..do	..do	.979	110	125	77.3

* Below.
** At room temperature.

ROAD OILS—1914.

Specific viscosity $\frac{50}{25}$ °C.	Loss on evaporation, 5 hrs. at 163°C. in per cent.	Solid residue at 5 mm. penetration, 25°C., 100 gm., 5 sec. in per cent.	Character of residue obtained by evaporation of oil to 5 mm. penetration.	Bitumen soluble in CS_2 in per cent.	Organic matter insoluble in CS_2 in per cent.	Bitumen insoluble in 86° B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
.....	23.5	.....	Rather greasy residue....	100	0.0	0.7	2.0	0.0	Not enough oil for specific viscosity test.
4.5	16.3	.....	Greasy, high in paraffins.	100	0.0	0.5	1.7	0.0	
3.5	20.9	.....	..do.....	100	0.0	0.5	2.0	0.0	
7.7	9.22	54.5	..do.....	100	0.0	0.5	2.6	0.0	
3.1	19.4	.....	..do.....	99.9	0.0	0.5	1.5	0.1	
17.2	8.63	65.6	..do.....	100	0.0	0.6	3.5	0.0	
.....	26.4	29.4	..do.....	99.9	0.1	0.4	1.7	0.0	Not enough oil for specific viscosity test.
.....	5.5	61.4	Fairly sticky residue.....	100	0.0	9.4	7.3	0.0	Not enough oil for specific viscosity test.
.....	9.8	44.5	Greasy, high in paraffins.	100	0.0	0.1	2.1	0.0	Not enough oil for specific viscosity test.
11.0	12.4	60.1	..do.....	100	0.0	0.5	3.3	0.0	
.....	14.1	46.0	..do.....	100	0.0	0.1	1.6	0.0	Not enough oil for complete tests.
.....	9.5	42.5	..do.....	99.9	0.0	0.3	2.4	0.1	Not enough oil for specific viscosity test.
.....	5.2	50.1	..do.....	99.9	0.0	0.5	2.5	0.1	Not enough oil for specific viscosity test.
.....	7.3	60.1	Fairly sticky residue.....	99.9	0.1	6.0	5.6	0.0	Not enough oil for specific viscosity test.
.....	15.2	51.0	Greasy, high in paraffins.	99.9	0.0	9.2	2.3	0.1	Not enough oil for complete tests.

ROAD OILS—1915.

Specific viscosity $\frac{100°}{25°}$ C.	Loss on evaporation, 5 hrs. at 163°C. in per cent.	Solid residue at 10 mm. penetration, 25°C., 100 gm., 5 sec., in per cent.	Character of residue obtained by evaporation of oil to 10 mm. penetration.	Bitumen soluble in CS_2 in per cent.	Organic matter insoluble in CS_2 in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
.....	59.6	.....	.....	99.8	0.0	15.1	4.8	0.2	
11.9	4.2	.....	.....	99.9	0.0	6.9	4.9	0.1	
45.0	1.7	.....	.....	99.7	0.2	20.0	11.6	0.1	
68.0	1.1	.....	.....	99.9	0.1	24.0	15.0	0.1	
.....	24.9	.....	.....	99.9	0.0	17.8	7.9	0.1	
4.9	9.6	.....	.....	99.9	0.0	13.8	7.6	0.1	
.....	26.6	.....	.....	99.9	0.0	9.4	5.2	0.1	
6.6	15.6	.....	.....	99.8	0.0	10.0	6.3	0.2	
.....	26.3	.....	.....	99.9	0.0	6.7	5.0	0.1	
5.8	16.3	.....	.....	99.9	0.0	9.7	5.9	0.1	

§ Too thick.

ABLE II—

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25°}{25°}$ C.	Flash point in °C.	Burning point in °C.	Specific viscosity $\frac{50°}{25°}$ C.
1171	Standard Asphalt Flux 11° Gravity.	Standard Oil Co., New Jersey.	G. W. Lamson, Railway Exchange Building, Chicago, Ill.	.986	180	215	.....
1172	80-80 L-5 Asphaltum	..do.....	..do.....	.981	155	195	.....
1186	L-6 Asphaltum.	Standard Oil Co., Richmond, Cal.	do.....	.973	180	214	.....
1187	L-4 Asphaltum.....	..do.....	..do.....	.983	196	233	.....
1188	L-3 Asphaltum.....	..do.....	..do.....	.988	222	235	.....
1195	60-65% Asphalt Road Oil.	Cosden & Co., Bigheart, Okla.	Cosden & Co., Bigheart, Okla.	.933	155	210	30.0
1209	.....	Johnson Oil Refining Co., Chicago Heights, Ill.	Johnson Oil Refining Co., Chicago Heights, Ill.	.926	165	190	18.7
1232	22-24 Road Oil.....	.....	C. W. Bird, Minier, Ill...	.913	157	174	8.4
1239	45-50% Road Oil.	Indian Refining Co., Lawrenceville, Ill.	Indian Refining Co., Lawrenceville, Ill.	.924	181	204	18.0
1240	60-65% Road Oil.....	..do.....	..do.....	.938	216	237	32.0
1241	85-90% Road Oil.....	..do.....	..do.....	.972	265	295	.....
1265	Texaco 12°-14° Gravity No. 1028 flux.	John Baker, Jr., Otis Building, 10 South LaSalle St., Chicago, Ill.	John Baker, Jr., 10 S. LaSalle St., Chicago, Ill.	.965	284	314	.....
1279	.....	.....	C. W. Bird, Minier, Ill...	1.095	183	206	13.0
1305	60% Asphaltum.....	.....	C. W. Faltz, Somonauk, Ill.	.938	220	246	40.0
1306	Road Oil No. 31.....	Bartles-Sweney Oil Co., Peoria, Ill.	G. W. Bird, Minier, Ill.	.918	133	160	11.5
1307	.....	.....	Mayor John W. Meyer, Mt. Pulaski, Ill.	1.005	193	213	16.0
1310	.....	.....	H. A. Shields, Greenfield, Ill.	.900	95	135	3.7
1313	45-50% Road Oil.....	Indian Refining Co., Cincinnati, Ohio.	F. M. Enos, C. S. H., Kankakee, Ill.	.924	181	204	.....
1314	60-65% Road Oil.....	..do.....	..do.....	.936	216	237	.....
1326	.....	.....	H. Huggins, Farmers National Bank, Knoxville, Ill.	.907	157	180	5.5
1327	45-50% Road Oil.....	Indian Refining Co., Lawrenceville, Ill.	H. V. Schroeder Mfg. Co., Minier, Ill.	.924	181	204	18.0
1339	.....	.....	W. S. Henderson, C. S. H., Rushville, Ill.	.905	157	175	5.5
1381	Montezuma Crude...	Warner-Quinlan Asphalt Co., Syracuse, N. Y	Theo. Plack Office.	.989	85	100	.....
1384	.....	.....	C. R. A. Marshall, C. S. H., Stronghurst, Ill.	.902	114	148	5.4
1410	Montezuma Crude...	Warner-Quinlan Asphalt Co., Syracuse, N. Y	D. S. James, Rockford, Ill.	.984	63	90	85
1426	60% Asphaltum.....	Pennsylvania Oil & Supply Co.	J. A. Miller, Galva, Ill....	.931	182	204	.....
1435	No. 4 Road Oil.....	.....	John Mensendick, West Point, Ill.	.988	181	193	.....
1445	.....	.....	J. A. Whitney, Chairman, Lostant, Ill.	.903	116	152	.....
1446	.....	.....	H. J. Stokes, City Engineer, Kewanee, Ill.	1.029	200	218	44
1462	.....	.....	H. Huggins, Knoxville, Ill.	.925	158	188	17
1473	Astec Liquid.....	U. S. Asphalt Refining Co., New York.	D. S. James, Rockford, Ill.	.929	34	60	7.2
1477	.....	.....	W. P. Graham, Rochelle, Ill.	.843	.....	.....	.....
1480	.....	.....	J. R. Whitney, Lostant Ill.	1.010	186	198	7.5
1488	.....	.....	E. J. Grossenburg, Woodhull, Ill.	.910	150	178	.....

† Foams.

Continued.

Specific viscosity $\frac{100°\text{ C.}}{25°}$	Loss on evaporation, 5 hrs. at 163°C. in per cent.	Solid residue at 10 mm. penetration, 25°C., 100 grm., 5 sec., in per cent.	Character of residue obtained by evaporation of oil to 10 mm. penetration.	Bitumen soluble in CS_2 in per cent.	Organic matter insoluble in CS_2 in per cent.	Bitumen insoluble in 86°B. naphtha in per cent. of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
20.4	4.5	.....	.....	99.9	0.0	17.9	10.3	0.1	
8.7	4.7	.....	.....	100.0	0.0	4.4	5.0	0.0	
5.6	5.4	.....	.....	100.0	0.0	3.7	4.4	0.0	
10.4	3.7	.....	.....	100.0	0.0	4.4	5.1	0.0	
21.0	1.9	.....	.....	99.9	0.0	4.8	5.8	0.1	
.....	4.4	.....	.....	99.7	0.2	1.6	3.6	0.1	
.....	6.3	.....	.....	99.9	0.0	1.9	3.4	0.1	
.....	8.9	.....	.....	99.9	0.0	1.1	2.8	0.1	
.....	3.4	.....	.....	99.9	0.1	0.9	2.6	0.0	
.....	0.9	68	Slightly adhesive...	99.9	0.0	1.5	3.5	0.1	
11.2	0.1	81	Short, greasy.....	99.8	0.0	5.4	7.0	0.2	
10.9	0.7	75	Adhesive.....	99.9	0.1	3.0	5.5	0.1	
.....	3.7	.....	.....	99.9	0.1	7.3	7.1	0.1	
.....	1.0	68	Short, greasy.....	99.9	0.0	1.2	3.4	0.1	
.....	8.2	.....	.....	99.8	0.2	2.6	2.5	0.0	
.....	2.7	69	Fairly sticky.....	100.0	0.0	7.0	6.3	0.0	
.....	14.6	32	Paraffin base	100.0	0.0	0.3	1.3	0.0	
.....	3.4	.....	.....	99.9	0.0	1.0	2.6	0.1	Not enough for viscosity test.
.....	0.9	.....	.....	99.9	0.0	1.5	3.5	0.0	Not enough for viscosity test.
.....	11.7	.....	.....	99.8	0.15	0.5	2.1	0.05	
.....	3.4	.....	.....	99.9	0.0	1.0	2.6	0.1	
.....	9.0	39	Short, greasy.....	99.7	0.2	1.2	2.0	0.1	
12.6	†15-20	.....	.....	99.9	0.0	18.3	9.1	0.1	
.....	13.7	37	Short, greasy.....	99.9	0.0	0.7	1.8	0.1	
10.2	16.6	76	Sticky.....	99.9	0.1	16.8	10.1	0.0	
.....	4.4	56	Slightly adhesive...	99.8	0.0	1.6	4.5	0.2	Not enough for viscosity.
.....	3.7	58	Adhesive.....	100.0	0.0	6.6	6.5	0.0	Not enough for viscosity.
.....	11.1	32	Short, greasy.....	100.0	0.0	0.7	2.2	0.0	Not enough for viscosity.
.....	1.6	71	Adhesive.....	100.0	0.0	10.9	8.7	0.0	
.....	2.4	52	Slightly adhesive...	99.8	0.1	1.7	3.6	0.1	
.....	27.4	56	Very adhesive.....	100.0	0.0	12.2	7.2	0.0	
.....	.....	25	Short, greasy.....	100.0	0.0	0.6	1.5	0.0	Not enough for complete test.
.....	3.9	54	Adhesive.....	100.0	0.0	5.5	6.4	0.0	
.....	8.6	44	Short, greasy.....	99.9	0.0	1.1	2.8	0.1	Not enough for viscosity.

TABLE II—

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25°}{25°}$ C.	Flash point in °C.	Burning point in °C.	Specific viscosity $\frac{50°}{25°}$ C.
1492			Dr. J. H. Butler, Hartsburg, Ill.	1.011	182	206	11.4
1500			H. G. Stokes, City Engineer, Kewanee, Ill.	1.034	210	238	66.4
1501			do	.938	194	218	.....
1506	Standard No. 5	Standard Oil Co	S. E. Bradt, State Highway Commission.	1.037	200	228	27.5
1523			E. R. Rhoades, Delavan, Ill.	.908	118	162	5.0
1526		Indian Refining Co	R. O. Edwards, C. S. H., Bellflower, Ill.	.923	178	210	16.9
1527	Crude Oil		M. W. Bonham, Macomb, Ill.	.850	*25	‡25	1.3
1557			P. A. Clark, Dixon, Ill	.902	116	152	.....
1560	Cat Canyon Crude	Pinal-Dome Refining Co., Santa Maria, Cal.	Pinal-Dome Refining Co., Santa Maria, Cal.	.964	28	46	38
1561	90% Roadoleum	do	do	1.009	226	276	.....
1565			E. E. Hussemann, Roanoke, Ill.	.902	112	152	5.0
1566			do	.908	145	172	7.7
1567			do	.908	142	172	8.4
1568			E. J. Grossenburg, Woodhull, Ill.	.908	148	172	6.4
1586			F. H. Reed, Farmer City, Ill.	.926	191	210	20.3
1587	Montezuma Crude No. 402.		Warner-Quinlan Asphalt Co., 79 Wall St., New York City.	.930	43	59	11.1
1588	Montezuma Road Oil No. 406.		do	.943	120	145	11.1
1599			E. L. Buchman, Lacon, Ill.	.908	175	225	.....
1607			Henry Nourie, Beaverville, Ill.	.926	196	225	.....
1608			L. B. Neighbour, Dixon, Ill.	1.047	211	230	67
1612			E. R. Rhoades, Delavan, Ill.	.918	205	233	14.2
1613	Standard No. 4	Standard Oil Co	do	1.013	144	218	12.3
1620	Road Oil	Oklahoma Oil Co	Henry Blessman, Gridley, Ill.	.898	134	155	.....
1622			W. M. Bonham, C. S. H., Macomb, Ill..	.922	156	186	.....
1623			do	.924	152	187	.....
1624	Trinidad "B"	Barber Asphalt Co	D. S. James, Oregon, Ill..	.990	132	164	.....
1648	Astec Liquid		Theo. Plack, Cairo, Ill	.929	30	57	8.6
1704			Edwin C. White, C. S. H., Springfield, Ill.	.919	192	220	.....
1711		Riley-Pennsylvania Oil Co.	G. C. Fairclo, C. S. H., Urbana, Ill.	.918	118	140	10.4
1720	Standard Road Oil No. 4.	Standard Oil Co	C. A. Pennington, C. S. H., Taylorville, Ill.	1.016	185	208	.....
1751	Standard Road Oil No. 4.	do	G. C. Fairclo, Urbana, Ill.	1.008	198	217	14.5
1798	Standard Mexican Liquid Asphalt.	do	W. C. Miller, Sycamore, Ill.	.943	85	107	24.1
1799	Standard Mexican Liquid Asphalt.	do	do	.943	83	100	24.4

* Below.
‡ About.

Concluded.

Specific viscosity — 100° C. / 25°	Loss on evaporation, 5 hrs. at 163°C. in per cent.	Solid residue at 10 mm. penetration, 25°C., 100 gm., 5 sec., in per cent.	Character of residue obtained by evaporation of oil to 10 mm. penetration.	Bitumen soluble in CS_2 in per cent.	Organic matter insoluble in CS_2 in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
.....	1.5	51	Adhesive.....	99.9	0.0	6.2	6.1	0.1	
.....	1.6	73	..do.....	99.9	0.1	10.3	8.3	0.0	
.....	4.0	61	Slightly adhesive...	99.9	0.1	2.8	5.4	0.0	Not enough for viscosity.
.....	3.0	65	Adhesive.....	99.9	0.0	10.5	8.7	0.1	Contains some water.
.....	11.1	43	Short, greasy.....	100.0	0.0	1.1	1.9	0.0	
.....	4.0	51	..do.....	99.9	0.1	0.9	2.8	0.0	
.....	.....	29	..do.....	100.0	0.0	0.2	1.5	0.0	From wells near Macomb, flash too low for evaporation.
.....	15.6	38	..do.....	99.9	0.1	1.2	2.0	0.0	Not enough for viscosity test.
3.6	21.4	71	Very adhesive.....	99.9	0.0	14.2	7.1	0.1	Contains some water.
42.3	0.6	91	..do.....	99.8	0.0	15.6	10.2	0.2	
.....	13.6	52	Short, greasy.....	99.9	0.1	1.3	2.2	0.0	
.....	10.2	50	..do.....	99.9	0.0	2.0	2.2	0.1	
.....	8.7	54	..do.....	99.9	0.1	2.0	2.2	0.0	
.....	9.4	54	..do.....	99.9	0.0	1.2	2.2	0.1	
.....	2.1	50	Slightly adhesive...	99.9	0.0	1.9	3.1	0.1	
.....	26.7	62	Very adhesive.....	100.0	0.0	15.1	7.2	0.0	
.....	14.7	58	Adhesive.....	100.0	0.0	11.8	5.9	0.0	
.....	4.4	41	Short, greasy.....	99.9	0.0	0.5	1.3	0.1	Not enough for viscosity test.
.....	2.9	59	..do.....	99.9	0.1	1.2	2.8	0.0	Not enough for viscosity test.
4.1	1.1	73	Adhesive	100.0	0.0	13.8	9.3	0.0	
.....	1.6	51	Short, greasy.....	99.9	0.0	1.0	1.5	0.1	
.....	2.6	58	Adhesive.....	100.0	0.0	7.7	6.4	0.0	
.....	11.4	38	Short, greasy.....	99.7	0.2	0.6	1.3	0.1	Bottle contained about 20 per cent foreign matter in bottom.
.....	5.1	52	..do.....	99.9	0.0	1.2	2.4	0.1	Not enough for viscosity test.
.....	6.9	48	..do.....	99.8	0.0	2.5	2.3	0.2	Not enough for viscosity test.
8.8	8.7	75	Very adhesive.....	99.9	0.0	8.2	5.0	0.1	
.....	24.9	60	..do.....	99.9	0.0	13.7	6.5	0.1	
.....	3.0	49	Short, greasy.....	99.7	0.0	0.7	1.0	0.3	Not enough for viscosity test.
.....	14.3	52	Adhesive.....	99.7	0.1	3.6	4.4	0.2	
.....	2.9	64	..do.....	99.9	0.1	8.8	6.6	0.0	Not enough for viscosity test.
.....	5.9	.....	..do.....	100.0	0.0	8.5	6.8	0.0	
.....	19.1	65	Very adhesive.....	99.8	0.0	14.7	6.8	0.2	
.....	19.5	66	..do.....	100.0	0.0	15.1	6.5	0.0	

TABLE III—TESTS OF

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25}{25}$ °C.	Flash point in °C.	Burning point in °C.
1814	Roadoleum Sprinkling Oil.	Pinal Dome Refining Co., Santa Maria, Cal.	Pinal Dome Refining Co., Santa Maria, Cal.	0.941	80	92
1817	53% Montezuma Road Oil.	Warner-Quinlan Asphalt Co., 79 Wall St., New York.	John E. Sankey, Springfield, Ill.	0.953	97	120
1820	17° Sprinkling Oil (Special No. 4).	Pinal Dome Refining Co., Betteravia, Cal.	Pinal Dome Refining Co., Santa Maria, Cal.	0.946	61	78
1821	Residuum No. 6	..do	..do	0.929	66	78
1823	30% Road Oil.	Indian Refining Co., Lawrenceville, Ill.	Indian Refining Co., Lawrenceville, Ill.	0.887	112	123
1824	45–50% Road Oil	..do	..do	0.925	196	212
1825	60–65% Road Oil	..do	..do	0.941	230	252
1826	85–90% Road Oil	..do	..do	0.978	267	300
1834	Mexican Road Oil	.....	Bartles-Sweeney Oil Co., Peoria, Ill.	0.930	30	45
1837	35–40% Road Oil	Indian Refining Co., Lawrenceville, Ill.	Indian Refining Co., Lawrenceville, Ill.	0.892	121	144
1848	Texaco Asphaltic Base Road Oil.	.....	John Baker Jr., 540 Otis Building, Chicago, Ill.	0.977	257	300
1861	Mexican Road Oil	.....	G. N. Lamb, Aurora, Ill	0.930	25	36
1863	No. 501 Road Oil	Riley-Pennsylvania Oil Co., Burlington, Ia.	C. W. Bird, Minier, Ill	0.906	142	160
1870	Standard Asphalt Road Oil No. 3.	Standard Oil Co., Whiting, Ind.	W. H. Leonard, Standard Oil Co., Chicago, Ill.	0.982	181	204
1871	Standard Asphalt Road Oil No. 4.	..do	..do	1.013	192	204
1872	Standard Asphalt Road Oil No. 5.	..do	..do	1.043	196	216
1873	Standard Asphalt Road Oil No. 6.	..do	..do	1.053	203	227
1874	Standard Asphalt Road Oil No. 7.	..do	..do	1.062	219	241
1880	14 Gravity Mexican Road Oil.	.....	John Baker, Jr., 540 Otis Building, Chicago, Ill.	0.962	.....	.....
1881	16 Gravity Mexican Road Oil.	.....	..do	0.953	75	110
1895	22.1 Gravity Road Oil	Petroleum Products Co., 208 S. LaSalle St., Chicago, Ill.	Petroleum Products Co., 208 S. LaSalle St., Chicago, Ill.	0.917	196	219
1913	Magnolia Mexican Light No. 6 Road Oil (Hot Application).	.....	J. F. McGurk, 10 S. LaSalle St., Chicago, Ill	0.984	194	218
1914	Cat Canyon Crude (65–75%).	Pinal Dome Refining Co., Santa Maria, Cal.	Pinal Dome Refining Co., Santa Maria, Cal.	0.987	135	148
1930	Road Oil, Specifications A.	Johnson Oil Refining Co., Chicago Heights, Ill.	Benjamin Jordan, County Superintendent of Highways, Watseka, Ill.	0.925	134	155
1935	Mexican Road Oil, No. 1.	Gas Oil Co., 122 S. Michigan Av., Chicago, Ill.	..do	0.956	59	70
1943	Road Oil	.....	R. Earl Knox, Town Clerk, Alpha, Ill.	0.931	172	204
1950	Road Oil	.....	F. S. Wallich, Knoxville, Ill	0.907	152	182
1952	Road Oil	.....	Luke Fullerton, Highway Commissioner, Oquawka, Ill.	0.911	152	184

Specific viscosity $\frac{50}{25}$ °C.	Specific viscosity $\frac{100}{25}$ °C.	Loss on evaporation, 5 hrs. at 163°C., in per cent	Solid residue of 100 penetration, 25°C., 100 gm., 5 sec., in per cent by weight.	Character of residue obtained by evaporation of oil to 100 penetration.	Bitumen soluble in carbon disulphide in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
9.8	.....	24.4	58	Asphaltic, very adhesive.	99.8	0.0	8.1	3.8	0.2	Manufacturer's sample.
13.0	.....	20.9	55	..do.....	99.9	0.0	11.3	5.3	0.1	Manufacturer's sample.
11.1	.....	25.1	58	..do.....	99.6	0.0	9.5	3.5	0.4	Manufacturer's sample.
4.5	.....	32.9	47	..do.....	99.7	0.0	7.3	2.6	0.3	Manufacturer's sample.
2.2	.....	28.7	35	Semi-asphaltic, slightly adhesive.	100.0	0.0	0.6	0.8	0.0	Manufacturer's sample.
16.0	.....	4.4	56	..do.....	99.9	0.0	1.0	1.8	0.1	Manufacturer's sample.
53.3	.....	0.9	70	Semi-asphaltic, adhesive.	99.9	0.0	2.5	2.8	0.1	Manufacturer's sample.
.....	11.7	0.1	93	..do.....	99.8	0.1	9.4	7.5	0.1	Manufacturer's sample.
10.7	.....	25.1	63	Asphaltic, very adhesive	99.9	0.1	14.1	7.3	0.0	Manufacturer's sample.
2.5	.....	19.7	....	Semi-asphaltic, slightly adhesive.	99.9	0.1	0.4	1.0	0.0	Manufacturer's sample.
.....	16.0	0.3	86	Semi-asphaltic, adhesive.	99.5	0.4	6.3	5.1	0.1	Manufacturer's sample.
9.0	.....	24.2	....	Asphaltic, very adhesive	99.9	0.1	14.6	7.6	0.0	Used in Kane County.
5.5	.....	10.2	41	Semi-asphaltic, slightly adhesive.	99.9	0.0	1.3	1.6	0.1	Village of Minier, Tazewell County.
6.6	.....	4.9	43	Fairly adhesive.....	100	0.0	4.5	3.5	0.0	Manufacturer's sample.
19.3	.....	3.2	59	Adhesive.....	100	0.0	9.2	6.1	0.0	Manufacturer's sample.
18.5	.....	2.7	65	..do.....	100	0.0	12.9	8.1	0.0	Manufacturer's sample.
81.8	3.8	1.4	70	..do.....	100	0.0	13.4	8.9	0.0	Manuacturer's sample.
.....	6.1	2.4	76	..do.....	100	0.0	15.7	10.0	0.0	Manufacturer's sample.
41.4	.....	.....	....	Asphaltic, very adhesive	99.8	0.0	14.5	6.8	0.2	Contains some water. No tests requiring heating on account of foaming.
38.0	.....	17.3	65	..do.....	99.9	0.1	16.4	7.7	0.0	Producer's sample.
12.1	.....	3.6	50	Slightly adhesive.....	99.5	0.2	1.0	1.4	0.3	Producer's sample.
.....	26.0	3.3	82	Asphaltic, very adhesive	99.9	0.0	20.4	10.7	0.1	Producer's sample.
.....	9.0	13.2	76	..do.....	99.8	0.2	18.1	6.4	0.0	Producer's sample
10.5	.....	12.7	50	..do.....	99.9	0.0	5.0	4.3	0.1	Used in Fountain Creek Township, Iroquois County.
44.5	7.3	21.9	62	..do.....	99.9	0.1	15.4	8.3	0.0	Submitted as a specifications. A Road Oil.
22.7	.....	4.8	47	..do.....	99.9	0.0	5.3	4.2	0.1	Not enough for viscosity test.
.....	.....	8.5	38	Very slightly adhesive ..	99.8	0.2	0.8	1.6	0.0	Not enough for viscosity test. Used in Knox County.
4.7	.....	8.9	28	..do.....	99.9	0.1	0.7	1.7	0.0	Used at Oquawka, Henderson County.

TABLE III—

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25}{25}$ °C.	Flash point in °C.	Burning point in °C.
1965	Road Oil	Bartles-Sweeney Oil Co., Peoria, Ill.	Benjamin Jordan, County Superintedent of Highways, Watseka, Ill.	0.910	150	172
1976	Road Oil		F. S. Wallich, Knoxville, Ill.	0.909	145	175
1977	Standard Asphalt Road Oil No. 7.	Standard Oil Co.	T. Plack, Pekin, Ill.	1.048	216	245
1982	Road Oil		F. S. Wallich, Knoxville, Ill.	0.909	150	175
1983	Road Oil		Luke Fullerton, Commissioner of Highways, Oquawka, Ill.	0.911	160	184
1990	Road Oil		John H. Ehringer, Washburn, Ill.	0.909	173	196
1991	Road Oil		E. E. Hussemann, Roanoke, Ill.	0.910	142	167
1992	Road Oil		..do	0.909	146	172
1993	Road Oil	Riley Pennsylvania Oil Co., Burlington, Ia.	Riley Pennsylvania Oil Co., Burlington, Ia.	0.906	136	162
2007	Road Oil		W. H. Fry, Commissioner of Highways, Carlock, Ill.	0.882	100	120
2016	Road Oil	Mound City Oil & Supply Co., St. Louis, Mo.	Mound City Oil & Supply Co., St. Louis, Mo.	0.910	91	160
2017	Road Oil	..do	..do	0.903	92	138
2019	Road Oil		B. J. Anno, Cooksville, Ill.	1.008	189	212
2028	Road Oil		C. A. Axline, Commissioner of Highways, Wenona, Ill.	1.016	202	230
2034	Road Oil	Ardmore Refining Co., Tulsa, Okla.	Hanger & Maxfield Independent Oil Co., Bloomington, Ill.	0.918	148	176
2041	16 Gravity Mexican Oil.	Magnolia Petroleum Co., Beaumont, Tex.	J. F. McGurk, 10 S. LaSalle St., Chicago, Ill.	0.955	90	114
2042	12 Gravity Mexican Oil.	..do	..do	0.980	152	174
2043	10 Gravity Mexican Oil.	..do	..do	1.003	218	248
2055	Road Oil		J. H. Unland, Chairman Citizens Street Oil Com., Delavan, Ill.	0.901	142	162
2056	45–50% Road Oil	Indian Refining Co., Lawrenceville, Ill.	E.l White, County Superintendent of Highways, Springfield, Ill.	0.930	197	214
2067	Road Oil	Kansas Cooperative Ref. Co., Chanute, Kan.		0.942	206	241
2078	Road Oil, Healdton, Okla, Crude.		Riley Pennsylvania Oil Co., Burlington, Ia.	0.925	188	203
2079	Road Oil		H. B. Ulmer, Town Clerk, Anchor, Ill.	0.925	187	207
2080	Road Oil		P. B. Smallwood, Commissioner of Highways, Weldon, Ill.	1.010	....	....
2090	Road Oil		J. H. Rothery, Town Clerk, Cissna Park, Ill.	0.921	....	....
2101	Road Oil	Riley Pennsylvania Oil Co., Burlington, Ia.	F. S. Wallich, Knoxville, Ill.	0.938	200	241
2102	Road Oil	..do	H. G. Stokes, Kewanee, Ill.	0.916	102	144
2104	45–50% Road Oil	Indian Refining Co., Lawrenceville, Ill.	E. White, County Superintendent of Highways, Springfield, Ill.	0.930	193	218

Continued.

Specific viscosity 50 / 25 °C.	Specific viscosity 100 / 25 °C.	Loss on evaporation, 5 hrs. at 163°C., in per cent.	Solid residue of 100 penetration, 25°C., 100 gm., 5sec., in per cent by weight.	Character of residue obtained by evaporation of oil to 100 penetration.	Bitumen soluble in carbon disulphide in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
7.2	.....	10.0	39	Very slightly adhesive...	99.8	0.1	0.7	1.6	0.1	Used in Douglas Township, Iroquois County.
6.5	.....	13.0	30	Slightly adhesive.....	99.8	0.1	1.2	1.8	0.1	Proposed for use in Knox County.
.....	4.8	1.5	80	Adhesive.....	100	0.0	13.7	8.9	0.0	Gravel roads and bituminous resurfacing at Pekin in Tazewell County.
6.7	.....	13.5	32	Slightly adhesive.....	99.8	0.0	1.2	1.9	0.2	Proposed for use in Knox County.
6.2	.....	7.9	30	Very slightly adhesive...	99.9	0.1	0.7	1.6	0.0	Used at Oquawka, Henderson County.
7.6	.....	6.9	41	..do.....	99.8	0.1	0.5	1.1	0.1	Used at Washburn, Woodford County.
6.5	.....	9.5	34	Slightly adhesive.....	99.9	0.0	1.2	1.6	0.1	Used at Roanoke, Woodford County.
6.8	.....	11.3	32	..do.....	99.9	0.0	1.5	1.8	0.1	Used at Roanoke, Woodford County.
5.3	.....	13.0	33	..do.....	99.9	0.1	1.4	1.7	0.0	Producer's sample.
2.2	.....	19.5	28	Very slightly adhesive...	99.9	0.1	0.3	0.6	0.0	Used at Carlock, McLean County.
6.6	.....	10.8	45	Slightly adhesive.....	99.7	0.2	1.4	2.0	0.1	Producer's sample.
4.7	.....	13.6	42	..do.....	99.7	0.2	1.3	1.8	0.1	Producer's sample.
12.5	.....	4.3	59	Adhesive.....	100	0.0	6.9	6.0	0.0	Used at Cooksville, McLean County.
31.8	3.0	2.2	66	..do.....	100	0.0	9.1	7.2	0.0	Used in Evans Township, Marshall County.
13.2	.....	3.5	44	Slightly adhesive.....	100	0.0	1.7	2.0	0.0	Producer's sample.
33.3	4.0	17.5	66	Asphaltic, very adhesive	100	0.0	15.8	8.1	0.0	Producer's sample.
.....	15.3	7.5	79	..do.....	99.9	0.0	18.9	9.7	0.1	Producer's sample.
.....	46.4	1.0	89	..do.....	99.9	0.0	21.5	11.6	0.1	Producer's sample.
4.7	.....	13.4	35	Very slightly adhesive...	100	0.0	0.9	1.5	0.0	Used at Delavan, Tazewell County.
21.3	.....	3.9	49	Slightly adhesive.....	99.9	0.0	2.5	2.8	0.1	Preliminary sample.
34.1	3.2	2.9	54	..do.....	99.9	0.1	4.9	4.7	0.0	
17.6	.....	3.7	40	..do.....	99.9	0.0	1.3	2.2	0.1	Producer's sample.
17.7	.....	4.4	45	..do.....	99.9	0.0	2.0	2.6	0.1	Used at Anchor, McLean County.
.....	.....	3.7	55	Adhesive.....	99.9	0.0	7.4	6.1	0.1	Not enough for complete tests. Used in Nixon Township, DeWitt County.
.....	.....	11.5	46	Slightly adhesive.....	99.9	0.1	2.2	3.7	0.0	Not enough for complete tests. Used in Pigeon Grove Township, DeWitt County.
38.2	3.0	2.8	50	..do.....	99.9	0.1	5.2	4.5	0.0	Proposed for use at Knoxville, Knox County.
7.0	.....	13.4	46	..do.....	99.8	0.1	2.5	2.9	0.1	Used at Kewanee, Henry County.
24.6	.....	2.5	52	..do.....	99.9	0.0	2.2	2.8	0.1	Used in Rochester Township, Sangamon County.

TABLE III—

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25}{25}$ °C.	Flash point in °C.	Burning point in °C.
2115	Road Oil	Bartles-Sweeney Oil Co., Peoria, Il.	A. B. Hurd, County Superintendent of Highways, ElPaso, Ill.	0.911	146	172
2121	Road Oil		Dr. J. A. Gustafson, Orion, Ill.	1.007	185	210
2129	20 Gravity Road Oil	Riley Pennsylvania Oil Co., Burlington, Ia.	Riley Pennsylvania Oil Co., Burlington, Ia.	0.928	151	197
2132	Road Oil		G. D. Palmer, Mayor, Galva, Ill.	0.917	118	140
2133	Road Oil		Thomas Campbell, Bellflower, Ill.	0.912	135	163
2134	Road Oil		..do	0.906	118	145
2135	Road Oil		E. N. Stephenson, Town Clerk, Woodhull, Ill.	0.916	107	133
2136	Road Oil		E. J. Grossenburg, Woodhull, Ill.	0.913	107	136
2137	Road Oil	The Mound City Oil & Supply Co., 204 N. Commercial St., St. Louis, Mo.	The Mound City Oil & Supply Co. St. Louis, Mo.	0.917	163	186
2138	Road Oil		E. C. Richoz, Goodwine, Ill.	0.917	159	185
2139	Standard Asphalt Road Oil No. 5.	Standard Oil Co	Benjamin Jordan, County Superintendent of Highways, Watseka, Ill.	1.020	198	228
2146	20½ Gravity Road Oil	Kansas Oil Refining Co., Coffeyville, Kans.	H. L. Deming, Manager, Kansas Oil Refining Co., Coffeyville, Kans.	0.929	202	231
2147	21½ Gravity Road Oil	..do	..do	0.922	192	219
2148	22½ Gravity Road Oil	..do	..do	0.916	166	187
2149	23½ Gravity Road Oil	..do	..do	0.911	162	184
2150	Road Oil		V. C. Boynton, Commissioner of Highways, Vermont, Ill.	0.907	138	174
2151	Road Oil	Bartles-Sweeney Oil Co., Peoria, Ill.	..do	0.912	156	183
2152	Road Oil		R. W. Osborn, Forrest, Ill	1.008	184	205
2153	20 Gravity Road Oil	Eastern Kansas Oil Co., Moran, Kans.	F. W. Young, Rock Island, Ill	0.930	176	203
2156	Road Oil		F. S. Wallich, Knoxville, Ill	0.936	189	225
2167	No. 4 Road Oil	Hanger & Maxfield, 422 N. Main St., Bloomingington, Ill.	Hanger & Maxfield, 422 N. Main St. Bloomington, Ill	1.010	186	207
2170	Road Oil	Riley Pennsylvania Oil Co., Burlington, Ia.	E. N. Stephenson, Town Clerk, Woodhull, Ill.	0.918	108	139
2177	Road Oil		T. A. Campbell, Bellflower, Ill.	0.975	149	168
2179	Road Oil	Indian Refining Co., Lawrenceville, Ill.	Bureau of Maintenance, State Highway Department, Springfield, Ill.	0.928	197	216
2181	Road Oil		E. N. Stephenson, Town Clerk, Woodhull, Ill.	0.912	110	140
2188	Road Oil		Frank Jones, Commissioner of Highways, Seaton, Ill.	0.926	144	187

Continued.

Specific viscosity $\frac{50}{25}$ °C.	Specific viscosity $\frac{100}{25}$ °C.	Loss on evaporation, 5 hrs. at 163°C., in per cent.	Solid residue of 100 penetration, 25°C., 100 gm., 5 sec., in per cent by weight.	Character of residue obtained by evaporation of oil to 100 penetration.	Bitumen soluble in carbon disulphide in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
6.4	.....	9.0	35	Slightly adhesive.....	99.8	0.2	1.2	1.8	0.0	Used at Roanoke, Woodford County.
18.0	.....	4.7	59	Adhesive.....	99.9	0.1	8.2	6.2	0.0	A trace of water. Used at Orion, Henry County.
21.1	.....	7.8	58	Slightly adhesive.....	99.9	0.0	2.7	2.9	0.1	Contains some water. Producer's sample.
.....	.....	13.3	47	..do.....	99.8	0.1	2.4	2.7	0.1	Not enough for viscosity test. Used at Galva, Henry County.
9.4	.....	9.3	42	Very slightly adhesive..	99.9	0.0	0.7	1.6	0.1	Used at Bellflower, McLean County.
5.8	.....	14.5	35	..do.....	99.9	0.0	0.9	1.6	0.1	Used at Bellflower, McLean County.
6.7	.....	15.9	42	Slightly adhesive.....	99.9	0.0	1.7	2.3	0.1	Used at Woodhull, Henry County.
.....	.....	15.4	42	..do.....	99.9	0.0	1.5	2.3	0.1	Not enough for viscosity test. Used at Woodhull, Henry County.
9.6	.....	7.3	45	..do.....	99.9	0.1	2.3	2.7	0.0	Producer's sample.
10.2	.....	7.3	46	..do.....	99.9	0.0	2.2	2.9	0.1	Used in Fountain Creek Township, Iroquois County.
40.0	3.0	2.1	65	Adhesive.....	99.9	0.0	8.6	7.4	0.1	Used in Papineau Township, Iroquois County.
24.3	3.3	3.0	53	Slightly adhesive.....	99.9	0.1	2.5	2.5	0.0	Producer's sample.
16.5	.....	3.4	49	..do.....	99.9	0.1	1.6	2.5	0.0	Producer's sample.
9.8	.....	7.4	43	..do.....	100	0.0	1.3	2.1	0.0	Producer's sample.
7.5	.....	7.9	40	..do.....	99.9	0.0	1.5	1.8	0.1	Producer's sample.
.....	.....	9.6	36	..do.....	99.9	0.0	1.0	1.6	0.1	Not enough for viscosity test. Used at Vermont, Fulton County.
.....	.....	6.6	38	..do.....	99.9	0.1	1.5	1.7	0.0	Not enough for viscosity test. Used at Vermont, Fulton County.
12.0	.....	5.4	50	Adhesive.....	99.9	0.1	6.0	5.5	0.0	Furnished under specifications A. Used in Livingston County.
16.0	.....	4.7	52	..do.....	99.9	0.0	5.4	4.0	0.1	Used in Rock Island County.
23.3	.....	5.5	46	..do.....	99.9	0.0	5.1	4.1	0.1	Used at Knoxville, Knox County.
.....	.....	3.3	51	..do.....	100	0.0	7.0	5.8	0.0	Not enough for viscosity test.
12.7	.....	13.7	42	Slightly adhesive.....	99.9	0.0	2.3	2.7	0.1	Contains a trace of water. Used at Woodhull, Henry County.
10.2	.....	12.7	43	Very slightly adhesive...	99.8	0.1	0.8	1.6	0.1	Used at Bellflower, McLean County.
22.7	3.0	3.6	52	Slightly adhesive.....	99.9	0.0	1.8	2.6	0.1	Armington Road, Hittle Township, Tazewell County.
8.0	.....	10.3	51	..do.....	99.8	0.2	1.5	1.8	0.0	Contains a trace of water. Used at Woodhull, Henry County.
18.6	.....	7.5	58	..do.....	99.8	0.1	2.6	2.7	0.1	Used in Arlington Township, Mercer County.

TABLE III—

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25}{25}$ °C.	Flash point in °C.	Burning point in °C.
2199	Road Oil		F. S. Cook, County Superintendent of Highways, Mackinaw, Ill.	0.928	198	220
2200	Road Oil		...do	0.928	197	218
2220	Road Oil		Augsburger & Noffziger, Hopedale, Ill.	0.928	198	222
2221	Road Oil	Standard Oil Co	F. R. Bryant, County Superintendent of Highways, Princeton, Ill.	1.010	192	210
2222	Road Oil	Riley Pennsylvania Oil Co., Burlington, Ia.	Riley Pennsylvania Oil Co., Burlington, Ia.	0.907	133	165
2226	Road Oil	Bartles-Sweeney Oil Co., Peoria, Ill.	A. B. Hurd, County Superintendent of Highways, ElPaso, Ill.	0.916	171	192
2227	Road Oil		F. S. Cook, County Superintendent of Highways, Mackinaw, Ill.	0.912	130	146
2228	Road Oil	Mound City Oil & Supply Co., 204 N. Commercial St., St. Louis, Mo.	Mound City Oil & Supply Co., St. Louis, Mo.	0.920	137	156
3003	Road Oil		F. S. Wallich, Knoxville, Ill.	1.016	202	226
3007	Road Oil		R. M. Allely, Secretary Commercial Club, Sherrard, Ill.	0.890	93	110
3008	Road Oil		Dr. A. A. Mertz, Pawnee, Ill	0.925	190	208
3010	Road Oil		F. W. Young, Rock Island, Ill..	0.928	174	200
3023	Road Oil		T. A. Campbell, Commissioner of Highways, Bellflower, Ill.	0.912	155	177
3024	Road Oil	Hanger & Maxfield, 422 N. Main St. Bloomington, Ill.	Hanger & Maxfield, 422 N. Main St., Bloomington, Ill.	0.889	131	153
3025	Road Oil		F. S. Cook, County Superintendent of Highways, Mackinaw, Ill.	0.958	195	218
3026	Road Oil		...do	0.926	197	218
3039	Road Oil	Standard Oil Co	A. B. Hurd, County Superintendent of Highways, ElPaso, Ill.	1.008	191	214
3042	50% Asphaltic Road Oil	Johnson Oil Refining Co., Chicago Heights, Ill.	Arthur Cording, Town Clerk, Chatsworth, Ill.	0.922	....	....
3043	Road Oil	..do	Benj. Jordan, County Superintendent of Highways, Watseka, Ill.	0.917	165	187
3044	Road Oil	..do	...do	0.916	165	185
3045	Road Oil		J. L. Unland, Chairman Street Oil Committee, Delavan, Ill.	0.913	187	213
3046	60% Road Oil		G. D. Palmer, Mayor, Galva, Ill.	0.917	128	157
3051	Road Oil		Arthur Cording, Town clerk, Chatsworth, Ill.	0.917	166	187
3058	Road Oil		Cocking Cement Co., Taylorville, Ill.	0.927	197	224
3061	Road Oil		Geo. Schopmeyer, Taylorville, Ill.	0.930	200	227
3063	Road Oil		Ed. J. Dertinger, City Clerk, Bushnell, Ill.	0.923	167	189
3064	Road Oil		Wm. H. Smith, County Superintendent of Highways, Joliet, Ill.	1.010	188	205
3071	Road Oil		Albert S. McElhinney, Stronghurst, Ill.	0.913	181	202

Continued.

Specific viscosity 50/25 °C.	Specific viscosity 100/25 °C.	Loss on evaporation, 5 hrs. at 163°C., in per cent.	Solid residue of 100 penetration, 25°C., 100 gm., 5 sec., in per cent by weight.	Character of residue obtained by evaporation of oil to 100 penetration.	Bitumen soluble in carbon disulphide in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
23.6	.....	3.0	53	Slightly adhesive.....	99.9	0.0	1.9	2.4	0.1	Used at Tremont, Tazewell County.
22.9	.....	3.1	51	..do.....	99.9	0.1	1.8	2.2	0.0	Used in Morton Township, Tazewell County.
.....	.....	2.8	48	..do.....	99.9	0.1	1.7	2.6	0.0	Used at Hopedale, Tazewell County.
16.4	.....	5.1	58	Adhesive.....	100	0.0	6.8	5.5	0.0	Used at Zearing, Ill. in Berlin Township, Bureau County.
7.4	.....	10.1	37	Very slightly adhesive...	99.9	0.1	0.8	1.4	0.0	
10.4	.....	8.3	46	Slightly adhesive.....	99.9	0.0	2.8	2.8	0.1	Used at Roanoke, Woodford County.
9.0	.....	16.0	53	Some blistering of residue	99.8	0.0	2.2	2.4	0.2	Used in Mackinaw Township, Tazewell County.
12.3	.....	12.8	59	Slightly adhesive.....	99.9	0.1	2.2	2.7	0.0	
34.7	3.0	1.6	65	Adhesive.....	99.8	0.0	10.0	7.0	0.2	Used at Knoxville, Knox County.
2.3	.....	25.0	32	Very slightly adhesive...	99.9	0.1	1.0	1.1	0.0	Used at Sherrard, Mercer County.
19.6	.....	4.0	47	Slightly adhesive.....	99.9	0.1	1.3	2.2	0.1	Used at Pawnee, Sangamon County.
17.3	.....	5.4	54	Adhesive.....	99.8	0.1	5.4	4.0	0.1	Used at Milan, Rock Island County.
9.7	.....	12.0	41	Very slightly adhesive...	100	0.0	0.9	1.4	0.0	Used at Belleflower, McLean County.
3.6	.....	14.0	36	..do.....	99.9	0.1	0.6	1.0	0.0	
27.6	.....	5.2	58	Slightly adhesive.....	98.7	0.3	3.9	3.5	1.0	Used in Mackinaw Township, Tazewell County.
23.7	.....	3.1	52	..do.....	99.9	0.0	1.9	2.8	0.1	Used in Little Mackinaw Township, Tazewell County.
15.2	.....	4.9	58	Adhesive.....	99.9	0.1	6.6	5.6	0.0	Used in Metamora Township, Woodford County.
.....	.....	5.8	53	Very slightly adhesive...	99.8	0.1	1.1	1.9	0.1	Used at Chatsworth, Livingston County.
10.0	.....	7.2	47	Slightly adhesive.....	99.8	0.1	2.8	3.0	0.1	Used in Artesia Township, Iroquois County.
9.5	.....	10.2	47	..do.....	99.8	0.1	2.5	2.8	0.1	Used in Fountain Creek Township, Iroquois County.
10.0	.....	3.9	42	Very slightly adhesive...	99.9	0.0	0.6	1.3	0.1	Used at Delavan, Tazewell County.
9.0	.....	10.9	48	Slightly blistered.....	99.8	0.1	2.1	2.0	0.1	Used at Galva, Henry County.
.....	.....	8.2	48	Slightly adhesive.....	99.9	0.1	2.4	2.6	0.0	Used at Chatsworth, Livingston County.
21.0	.....	2.4	52	..do.....	99.9	0.1	2.0	2.4	0.1	Used on Sec. B, Route 5, Christian County.
25.5	.....	2.8	49	..do.....	99.9	0.1	2.2	2.6	0.0	Used on Sec. B, Route 5, Christian County.
14.1	.....	7.1	52	..do.....	99.9	0.1	3.2	3.0	0.0	Used at Bushnell, McDonough County.
13.4	.....	5.8	57	Adhesive.....	99.9	0.0	7.7	5.8	0.1	Used in Will County.
10.3	.....	9.7	44	Very slightly adhesive...	100	0.0	0.5	1.2	0.0	Used at Stronghurst, Henderson County.

TABLE III—

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25}{25}$ °C.	Flash point in °C.	Burning point in °C.
3072	Road Oil	Johnson Oil Refining Co., Chicago Heights, Ill.	J. R. Hastings, Kirkwood, Ill.	0.911	138	166
3075	Road Oil	..do	B. Jordan, County Superintendent of Highways, Watseka, Ill.	0.901	151	166
3080	Road Oil	Indian Refining Co., Lawrenceville, Ill.	F. S. Cook, County superintendent of Highways, Mackinaw, Ill.	0.930	198	230
3085	Road Oil	..do	..do	0.928	196	226
3086	Road Oil		E. C. Richoz, Commissioner of Highways, Goodwine, Ill.	0.905	138	155
3087	Road Oil		..do	0.909	146	167
3088	Heavy Road Oil		..do	0.978	257	288
3097	Road Oil	Bartles-Sweeney Oil Co., Peoria, Ill.	A. B. Hurd, County Superintendent of Highways, ElPaso, Ill.	1.008	187	212
3099	Road Oil		John Warne, Town Clerk, Delavan, Ill.	0.927	193	220
3100	55-60% Road Oil		E. J. Grossenburg, Woodhull, Ill.	0.939	196	225
3101	Road Oil		A. Buckholz, Melvin, Ill	0.913	161	186
3104	Road Oil		..do	0.886	74	91
3105	Road Oil		Ed. J. Dertinger, City Clerk, Bushnell, Ill.	0.905	139	167
3108	Road Oil		E. N. Stephenson, Town Clerk, Woodhull, Ill.	0.939	198	227
3114	No. 10 Road Oil	Hanger & Maxfield, Bloomington, Ill.	Hanger & Maxfield, Bloomington, Ill.	0.910	104	124
3115	60% Road Oil		G. D. Palmer, Mayor, Galva, Ill.	0.936	213	248
3116	Road Oil		John Seigler, Leroy, Ill	0.916	157	185
3119	Road Oil		T. A. Campbell, Commissioner of Highways, Bellflower, Ill.	0.916	157	185
3123	Trinidad "C"	The Barber Asphalt Paving Co., New York.	Theo. Plack, Donovan, Ill	1.002	218	240
3124	Road Oil		H. J. Flegel, Leroy, Ill	0.920	....	....
3125	Road Oil		..do	0.920	....	....
3126	Road Oil		Will Smith, Anchor, Ill	0.903	92	117
3130	Road Oil		F. W. Young, Rock Island, Ill	0.932	174	198
3132	Road Oil		G. F. Hawk, Town Clerk, Melvin, Ill.	0.928	160	188
3133	Road Oil		H. J. Flegel, Leroy, Ill	0.900	123	144
3134	Road Oil		..do	0.920	146	170
3139	Road Oil	Bartles-Sweeney Oil Co., Peoria, Ill.	A. B. Hurd, County Superintendent of Highways, ElPaso, Ill.	1.006	187	210
3153	Road Oil	Johnson Oil Refining Co., Chicago Heights, Ill.	Benj. Jordan, County Superintendent of Highways, Watseka, Ill.	0.892	128	144
3154	Road Oil		T. A. Campbell, Commissioner of Highways, Bellflower, Ill.	0.914	113	133
3158	Road Oil		John Warne, Town Clerk, Delavan, Ill.	0.926	189	210

Continued.

Specific viscosity 50/25 °C.	Specific viscosity 100/25 °C.	Loss on evaporation, 5 hrs. at 163°C., in per cent.	Solid residue of 100 penetration, 25°C., 100 grm., 5 sec., in per cent by weight	Character of residue obtained by evaporation of oil to 100 penetration.	Bitumen soluble in carbon disulphide in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
8.8	.....	12.0	45	Very slightly adhesive...	99.9	0.1	0.8	1.4	0.0	Used at Kirkwood, Warren County.
6.0	.....	10.7	40	Slightly adhesive.....	99.9	0.0	1.8	2.4	0.1	Used in Ash Grove Township, Iroquois County.
25.1	.....	2.5	50	..do.....	99.9	0.1	2.3	3.1	0.0	Used in Hopedale Township, Tazewell County.
23.6	.....	3.3	52	..do.....	100	0.0	2.1	2.9	0.0	Used in Hopedale Township, Tazewell County.
5.0	.....	11.9	39	..do.....	100	0.0	1.8	2.3	0.0	Used in Fountain Creek Township, Iroquois County.
7.0	.....	11.0	42	..do.....	100	0.0	2.3	2.6	0.0	Used in Fountain Creek Township, Iroquois County.
.....	14.4	0.6	87	Adhesive.....	99.7	0.1	9.7	8.4	0.2	Used in Fountain Creek Township, Irouqois County.
15.0	.....	3.6	60	..do.....	99.9	0.0	8.6	5.8	0.1	Used at Minonk, Woodford County.
22.8	.....	3.5	52	Slightly adhesive.....	100	0.0	2.0	2.1	0.0	Used at Delavan, Tazewell County.
40.4	3.9	3.3	60	Adhesive.....	99.8	0.1	7.6	4.5	0.1	Used at Woodhull, Henry County.
8.4	.....	8.4	46	Slightly adhesive.....	99.9	0.0	1.2	2.1	0.1	Used at Melvin, Ford County.
3.1	.....	27.1	38	..do.....	99.9	0.1	1.7	1.6	0.0	Used at Melvin, Ford County.
5.8	.....	10.2	41	Very slightly adhesive..	99.9	0.0	0.3	1.0	0.1	Used at Bushnell, McDonough County.
42.5	4.2	3.0	59	Adhesive.....	99.8	0.1	7.2	4.5	0.1	Used at Woodhull, Henry County.
6.7	.....	20.0	57	Slightly blistered.....	99.9	0.1	2.7	3.0	0.0	Producer's sample.
44.0	4.6	1.6	56	Slightly adhesive.....	99.9	0.1	2.4	3.4	0.0	Used at Galva, Henry County.
10.0	.....	8.0	47	..do.....	99.9	0.0	2.2	2.4	0.1	Used in Empire Township, McLean County.
10.0	.....	8.4	42	..do.....	99.9	0.1	1.4	2.0	0.0	Used at Bellflower, McLean County.
.....	48.0	1.5	85	Asphaltic, very adhesive	99.9	0.1	8.6	5.8	0.0	Used at Donovan, Iroquois County.
.....	.....	15.1	60	Badly blistered.....	99.9	0.1	2.5	3.0	0.0	Used in Empire Township, McLean County. Not enough oil for complete tests.
.....	.....	12.8	59	..do.....	99.9	0.1	2.3	3.1	0.0	Used in Empire Township, McLean County. Not enough oil for complete tests.
5.0	.....	23.3	50	Somewhat blistered.....	99.9	0.1	2.4	2.6	0.0	Used at Anchor, McLean County.
23.9	.....	3.9	59	Adhesive.....	99.8	0.1	6.1	4.4	0.1	Used in Rock Island County.
20.5	.....	6.9	53	Slightly adhesive.....	99.9	0.0	3.4	3.5	0.1	Used in Peach Orchard Township, Ford County.
4.7	.....	18.8	43	..do.....	100	0.0	1.2	1.2	0.0	Used in Empire Township, McLean County.
12.9	.....	17.1	52	Somewhat blistered.....	99.9	0.1	2.2	2.0	0.0	Used in Empire Township, McLean County.
14.3	.....	4.5	61	Adhesive.....	99.8	0.2	8.5	6.6	0.0	Used at Minonk, Woodford County.
3.0	.....	19.0	33	Slightly adhesive.....	99.9	0.1	1.6	1.8	0.0	Used in Crescent and Iroquois Townships, Iroquois County.
8.2	.....	17.2	53	..do.....	100	0.0	2.9	3.2	0.0	Used at Bellflower, McLean County.
20.0	.....	3.3	49	..do.....	100	0.0	2.0	2.8	0.0	Used at Delavan, Tazewell County.

TABLE III—

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25}{25}$ °C.	Flash point in °C.	Burning point in °C.
3160	Road Oil	Mound City Oil & Supply Co., 204 N. Commercial St., St. Louis, Mo.	C. A. Penington, County Superintendent of Highways, Taylorville, Ill.	0.914	120	140
3170	Road Oil		W. C. Boynton, Commissioner of Highways, Vermont, Ill.	0.930	171	198
3177	Road Oil	Mound City Oil & Supply Co., 204 N. Commercial St., St. Louis, Mo.	C. A. Penington, County Superintendent of Highways, Taylorville, Ill.	0.921	117	137
3178	Road Oil		G. F. Hawk, Town Clerk, Melvin, Ill.	0.900	78	100
3179	Road Oil		..do	0.900	78	100
3185	Road Oil		G. C. Fairclo, County Superintendent of Highways, Urbana, Ill.	0.886	108	134
3186	Road Oil		W. J. Miller, Gerlaw, Ill	0.914	158	184
3187	Road Oil		..do	0.915	158	184
3193	Road Oil		G. F. Brown, Ancona, Ill	1.030	193	220
3194	Road Oil		C. B. Hoenscheid, Peru, Ill	1.007	178	204
3198	Road Oil		Van Dausen & Baumberger, Germantown, Ill.	1.006	180	203
3212	Road Oil		F. W. Young, Rock Island, Ill	0.930	173	197
3218	Road Oil		T. A. Campbell, Bellflower, Ill	0.914	163	185
3222	Road Oil		C. I. Bruggraf, Breese, Ill	1.007	189	223
3250	Road Oil		A. Cording, Town Clerk, Chatsworth, Ill.	0.980	258	291
3251	Road Oil	Mound City Oil & Supply Co., 204 N. Commercial St., St. Louis, Mo.	J. R. McAteer, Jacksonville, Ill	0.920	108	132
3257	40% Road Oil		F. W. Tieken, Piper City, Ill	0.916	108	132
3263	Road Oil	Mound City Oil & Supply Co., 204 N. Commercial St., St. Louis, Mo.	C. A. Penington, County Superintendent of Highways, Taylorville, Ill.	0.929	116	138
3264	Road Oil		E. C. Richoz, Commissioner of Highways, Goodwine, Ill.	0.959	81	114
3296	Road Oil	American Refining Co., Okmulgee, Okla.	E. B. Blough, Lacon, Ill	0.922	120	142
3313	6-S. Fluxing Asphalt.	Standard Oil Co	H. C. Peterson, Park Ridge, Ill.	1.045	210	238
3343	Road Oil	Riley Pennsylvania Oil Co., Burlington, Ia.	Riley Pennsylvania Oil Co., Burlington, Ia.	0.925	138	176
3344	Road Oil	American Refining Co., Okmulgee, Okla.	Geo. L. Judson, Pana, Ill	0.924	118	138
3393	Road Oil	Johnson Refineries, Lawrenceville, Ill.	C. M. Slaymaker, Division Engineer, East St. Louis, Ill.	0.924	164	192
3464	Road Oil	Indian Refining Co., Lawrenceville, Ill.	H. B. Emery, Decatur, Ill	0.923	177	197
3508	Road Oil		Carl R. French, Chatsworth, Ill	0.928	172	192
3509	Road Oil		..do	0.927	178	196
3510	Road Oil		..do	0.925	175	198

* Foams at 100°C.

Continued.

Specific viscosity 50/25 °C.	Specific viscosity 100/25 °C.	Loss on evaporation, 5 hrs. at 163°C., in per cent.	Solid residue of 100 penetration 25°C., 100 gm., 5 sec., in per cent by weight.	Character of residue obtained by evaporation of oil to 100 penetration.	Bitumen soluble in carbon disulphide in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
8.8	.....	16.8	46	Slightly adhesive.....	99.9	0.1	2.5	3.1	0.0	Used by town of Buckhart, Christian County.
18.8	.....	5.0	53	Adhesive.....	99.8	0.2	5.8	4.7	0.0	Used at Vermont, Fulton County.
9.6	.....	12.8	55	Slightly adhesive.....	99.8	0.2	3.3	3.0	0.0	Used by town of Buckhart, Christian County.
3.9	.....	24.3	39	..do.....	99.9	0.1	1.9	2.5	0.0	Used at Melvin, Ford County
.....	.....	24.3	39	..do.....	99.9	0.1	1.9	2.5	0.0	Used at Melvin, Ford Coun y. Not enough for viscosity test.
3.0	.....	17.3	27	Very slightly adhesive..	99.9	0.0	0.2	0.5	0.1	Used inChampaign County.
8.7	.....	8.0	47	Slightly adhesive.....	99.9	0.0	2.5	2.5	0.1	Used at Gerlaw, Warren County.
8.7	.....	8.0	47	..do.....	99.9	0.0	2.5	2.4	0.1	Used at Gerlaw, Warren County.
43.8	3.2	1.6	67	Adhesive.....	99.8	0.2	16.4	8.3	0.0	Used at Ancona, Livingston County.
11.1	.....	4.8	54	..do.....	99.9	0.0	7.5	5.7	0.1	Used at Peru, LaSalle County.
13.2	.....	3.8	54	..do.....	99.9	0.1	7.2	5.3	0.0	Used on Sec. B, Clinton County.
19.9	.....	4.7	53	Fairly adhesive.....	99.9	0.1	5.3	4.4	0.0	Used in Rock Island County.
9.2	.....	7.9	43	Slightly adhesive.....	99.9	0.0	2.4	2.4	0.1	Used at Bellflower, McLean County.
18.0	.....	2.5	55	Adhesive.....	99.9	0.1	7.8	5.5	0.0	Used on Sec. B, Clinton County
.....	18.3	1.8	82	Somewhat adhesive.....	99.7	0.2	9.8	7.1	0.1	Used at Chatsworth, Livingston County.
9.6	.....	15.8	54	Somewhat blistered.....	99.8	0.2	3.0	3.2	0.0	Used on Sec. B, Morgan County.
11.1	.....	23.0	42	Badly bli tered.....	99.5	0.2	4.3	3.4	0.3	Used in Brenton Township, Ford County.
10.4	.....	14.5	56	Somewhat blistered.....	99.9	0.1	3.1	3.5	0.0	Used by town of Buckhart, Christian County.
47.7	*	19.4	68	Very adhesive.....	99.9	0.1	15.4	8.0	0.0	Used in Fountain Creek Township, Iroquois County.
9.8	.....	15.3	54	Badly blistered.....	99.9	0.1	3.5	3.3	0.0	Used on Sec. D, Route 7 and 7A, Marshal Coun y.
.....	5.6	1.1	70	Adhesive.....	99.9	0.1	12.0	9.3	0.0	Preliminary sample.
19.1	.....	8.6	52	Slightly adhesive.....	99.8	0.1	3.0	2.8	0.1	Producer's sample.
10.4	.....	16.0	53	Slightly blistered.....	99.9	0.1	4.3	3.6	0.0	Used on Sec. C, Route 12, Christian County.
18.6	.....	5.5	49	Slightly adhesive.....	99.9	0.0	2.1	2.6	0.1	Used on Sec. D, Route 1, Greene County.
14.4	.....	4.2	46	..do.....	99.9	0.1	2.1	2.2	0.0	Used on Sec. A, Macon County.
21.2	.....	4.7	52	..do.....	99.8	0.2	2.4	2.6	0.0	Used on Sec. D, Routes 3 and 7, Livingston County.
22.5	.....	4.5	49	..do.....	99.8	0.2	2.1	2.4	0.0	Used on Sec. D, Routes 3 and 7, Livingston County.
16.1	.....	4.1	45	..do.....	99.9	0.1	2.0	2.0	0.0	Used on Sec. D, Routes 3 and 7, Livingston County.

TABLE III—

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Specific gravity $\frac{25}{25}$ °C.	Flash point in °C.	Burning point in °C.
3560	Road Oil		C. I. Burggraf, Trenton, Ill.	1.013	182	198
3572	Road Oil	Mound City Oil & Supply Co., 204 N. Commercial St., St. Louis, Mo.	C. A. Penington, County Superintendent of Highways, Taylorville, Ill.	0.919	122	154
3582	Road Oil		H. E. Morgan, Town Clerk, Buckley, Ill.	0.883	71	80
3597	Standard Asphalt Road Oil No. 4.	Standard Oil Co.	H. B. Emery, Decatur, Ill.	1.015	181	204
3620	Road Oil	do	do	1.014	180	203
3635	Road Oil	do	do	1.015	184	208
3674	Fluxing Asphalt	do	H. C. Peterson, Park Ridge, Ill.	1.045	214	238

TABLE IV—TESTS OF

Laboratory number.	Trade name.	Manufactured by—	Specific gravity at 25°C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. at 25°C.	Brittleness test at 5°C.
322	MontezumaAsphalt	Warner-Quinlan Asphalt Co.	1.042	56	270	310	Over 100	Very brittle.
323	Montezuma Asphalt	do	1.034	47	240	275	Over 100	Not brittle.
324	Montezuma Crude	do	0.985	Soft	85	115	Soft	Soft.
325	Maltha Brand Asphalt	Union Oil Co. of California.	1.036	44.5	220	250	Over 100	Slightly brittle.
327	Sarco Asphalt	Standard Asphalt & Rubber Co.	0.984	60	255	300	9.5	Not brittle.
328	Standard Asphalt Road Oil No. 2.	Standard Oil Co.	0.919	Liquid	155	175	Liquid	Liquid.
329	Standard Asphalt Road Oil No. 3.	do	0.922	Liquid	160	180	Liquid	do.
330	Standard Asphalt Road Oil, No. 5.	do	0.938	Liquid	160	180	Liquid	do.
331	Standard Asphalt Road Oil No. 6.	do	0.946	Liquid	155	175	Liquid	do.
332	Standard "A"	do	0.971	Soft	275	310	Soft	Soft.
333	Standard "B"	do	0.988	53	270	310	14	Not brittle.
334	Standard Paving Asphalt.	do	0.996	81	270	310	3	do.
335	Standard Paving Filler.	do	1.002	145	275	315	0	Slightly brittle.
339	Sunset Natural Road Oil	Union Oil Co. of California.	0.984	Soft	140	160	Soft	Soft.

* Semi liquid.
† Liquid residue.
[1] Manufacturer's sample.

Concluded.

Specific viscosity 50 / 25 —°C.	Specific viscosity 100 / 25 —°C.	Loss on evaporation, 5 hrs. at 163°C., in per cent.	Solid residue of 100 penetration, 25°C., 100 gm., 5 sec., in per cent by weight.	Character of residue obtained by evaporation of oil to 100 penetration.	Bitumen soluble in carbon disulphide in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Remarks.
7.7	.....	4.6	57	Adhesive.....	100	0.0	8.4	6.1	0.0	Used on Sec. C, Route 9, Clinton County.
8.7	.....	18.8	48	Somewhat Blistered.....	99.8	0.2	3.9	3.9	0.0	Used by town of Buckhart, Christian County.
.....	.....	35.5	35	Slightly adhesive.....	100	0.0	1.7	2.3	0.0	Used at Buckley, Iroquois County.
8.8	.....	6.8	57	Adhesive.....	100	0.0	8.3	6.3	0.0	Used on Sec. A, Macon County.
8.9	.....	6.3	51	..do.....	100	0.0	7.3	6.5	0.0	Used on Sec. A, Macon County.
8.6	.....	5.8	53	..do.....	100	0.0	8.6	6.3	0.0	Used on Sec. A, Macon County.
.....	5.9	1.5	....	..do.....	99.9	0.1	11.2	9.8	0.0	Used on Sec. 2, Route 5, bond issue roads, Cook County.

ASPHALTS—1913.

Penetration at 25°C., 100 gm., 5 sec., in mm.	Evaporation 5 hours at 163°C.			Total bitumen or per cent soluble in CS_2.	Organic matter insoluble in CS_2 in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
	Loss in per cent.	Penetration of residue in mm.	Change in penetration in per cent.						Road.	Township.	County.	
5.9	0.18	4.4	26	99.9	0.0	27.3	15.0	0.1	.....	.....	.....	(1)
14.2	0.80	9.7	32	99.9	0.0	25.5	13.9	0.1	.....	.....	.....	(1)
Soft	17.2	Soft	.....	99.9	0.0	19.1	10.4	0.1	.....	.....	.....	(1)
10.0	2.04	4.4	56	99.8	0.0	21.1	12.8	0.2	.....	.....	.....	(1)
5.9	0.34	5.2	12	99.5	0.0	23.9	11.0	0.5	.....	.....	.....	(1)
Liquid	15.4	Liquid	†	99.9	0.0	6.6	2.8	0.1	.....	.....	.....	(1)
Liquid	11.3	Liquid	†	100	0.0	7.3	3.2	0.0	.....	.....	.....	(1)
Liquid	10.3	Liquid	†	100	0.0	11.0	5.1	0.0	.....	.....	.....	(1)
Liquid	12.0	*	*	99.9	0.0	14.8	7.3	0.1	.....	.....	.....	(1)
Soft	0.20	Soft	Soft	99.9	0.0	6.0	6.0	0.1	.....	.....	.....	(1)
11.2	0.21	9.1	19	99.9	0.0	23.1	11.5	0.1	.....	.....	.....	(1)
4.8	0.18	3.9	18	100	0.0	29.0	14.0	0.0	.....	.....	.....	(1)
1.6	0.09	1.5	6	100	0.0	36.6	17.5	0.0	.....	.....	.....	(1)
Soft	16.1	Soft	.....	99.8	0.0	5.5	3.8	0.2	.....	.....	.....	(1)

TABLE IV—

Laboratory number.	Trade name.	Manufactured by—	Specific gravity at 25°C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. at 25°C.	Brittleness test at 5°C.
340	80-80 R. O. Maltha Brand Asphalt.	Union Oil Co. of California.	0.994	Soft	160	190	Soft	Soft.....
341	120-130 Penetration Maltha Brand Asphalt.	..do.....	1.026	44	245	280	Over 100	Slightly brittle.
342	40-50 Penetration Specification Asphalt.	..do.....	1.026	58	195	230	50	..do.....
343	D Grade U. O. Co. 42 Maltha Brand Asphalt.	..do.....	1.040	52	260	305	Over 100	Very brittle....
348	Adeline Sunset Macadam Binder.	Adeline Consolidated Road Oil Co.	0.985	Soft	150	170	Soft	Soft.....
349	18-20°B. Liquid Asphalt	Indian Refining Co.	0.935	Liquid	210	235	Liquid	Liquid.....
350	21-23°B. Liquid Asphalt	..do.....	0.914	Liquid	130	150	Liquid	..do.....
358	12-14°B. Asphalt Binder Hot Oil.	..do.....	0.975	Soft	270	300	Soft	Soft.....
452	Standard "C".....	Standard Oil Co....	1.009	61	235	270	9.5	Not brittle.....
465	Asphalt Filler.....	.....	0.989	.....	.....	.....	.....	.....
469	Trinidad "B".....	Barber Asphalt Co.	0.988	Soft	120	135	Soft	Soft.....
470	Trinidad "B".....	..do.....	0.989	Soft	110	130	Soft	..do.....
476	Adeline Sunset Liquid Asphalt No. 2.	National Petroleum Co.	0.992	Soft	150	185	Soft	..do.....
477	Adeline Sunset Asphalt Penetration 145.	..do.....	1.010	36	220	260	Over 100	Slightly brittle.
478	Adeline Sunset Asphalt Penetration 85	..do.....	1.016	46	250	285	Over 100	Brittle.....

[1] Manufacturer's sample.
[2] Repair work.
[3] Surface treatment.

TABLE V—TESTS OF

Laboratory number.	Trade name.	Manufactured by—	Specific gravity at 25°C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. at 25°C.	Brittleness test at 5°C.
560	.....	.....	0.991	130	285	315	1.5	Brittle.....
601	Mexican "C".....	Standard Oil Co..	1.036	48	265	295	Over 100	Not brittle.....
602	Astec Road Binder.....	U. S. Asphalt Refining Co.	1.035	43	255	285	Over 100	..do.....
653	Astec Road Binder.....	..do.....	1.036	48	258	290	Over 100	..do.....
654	Astec Road Binder.....	..do.....	1.040	41	255	293	Over 100	..do.....
655	Astec Road Binder.....	..do.....	1.035	45	255	285	Over 100	..do.....
656	Astec Road Binder.....	..do.....	1.040	45	255	285	Over 100	..do.....
721	Astec H. O.....	..do.....	1.013	37	240	265	Too soft	..do.....
725	Astec Road Binder.....	..do.....	1.036	41	253	282	Over 100	..do.....
732	Mexican "C".....	Standard Oil Co..	1.036	49	285	310	95	..do.....
759	Bit. Mat. H. O.....	Sun Co.....	1.000	27	222	242	Too soft	..do.....

[1] Penetration work.
[2] Manufacturer's sample.

Concluded.

Penetration at 25°C., 100 gm., 5 sec., in mm.	Evaporation 5 hours at 163°C.			Total bitumen or per cent soluble in CS_2.	Organic matter insoluble in CS_2 in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
	Loss in per cent.	Penetration of residue in mm.	Change in penetration in per cent.						Road.	Township.	County.	
Soft	6.8	Soft	.....	99.9	0.0	10.5	5.9	0.1	.....	.....	.....	(1)
12.5	0.81	6.8	46	99.9	0.0	16.4	10.7	0.1	.....	.....	.....	(1)
4.3	2.8	1.8	58	99.9	0.0	31.0	13.9	0.1	.....	.....	.....	(1)
3.8	0.24	2.2	42	99.9	0.0	20.0	13.2	0.1	.....	.....	.....	(1)
Soft	13.4	Soft	.....	99.9	0.0	6.4	4.6	0.1	.....	.....	.....	(1)
Liquid	1.82	Liquid	.....	100	0.0	1.2	3.3	0.0	.....	.....	.....	(1)
Liquid	13.7	Liquid	.....	100	0.0	0.7	2.4	0.0	.....	.....	.....	(1)
Soft	0.26	Soft	.....	99.9	0.0	9.9	8.3	0.1	.....	.....	.....	(1)
7.9	0.75	5.0	37	99.9	0.0	23.5	13.5	0.1	.....	Beardstown..	Cass.....	(2)
4.1	0.24	3.4	17	99.8	0.1	27.9	14.3	0.1	Sartwell Br. Floor.	Savanna.....	Carroll...	
Soft	15.1	Soft	.....	99.9	0.0	10.0	6.1	0.1	St. Louis.....	Collinsville...	Madison..	(2)
Soft	15.9	Soft	.....	99.9	0.0	10.1	5.9	0.1	..do.....	..do.....	..do.....	(2)
Soft	10.1	Soft	.....	99.8	0.0	4.5	5.0	0.2	.....	.....	.....	(1)
18.7	2.1	9.8	48	99.8	0.0	6.3	6.1	0.2	.....	.....	.....	(1)
8.5	0.83	5.0	41	99.8	0.0	8.6	6.8	0.2	.....	.....	.....	(1)

ASPHALTS—1914.

Penetration at 25°C., 100 gm., 5 sec., in mm.	Evaporation, 5 hours at 163°C.			Bitumen soluble in CS_2, in per cent.	Organic matter insoluble in CS_2, in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
	Loss in per cent.	Penetration of residue in mm.	Change in penetration in per cent.						Road or section.	Township or route.	County.	
1.7	0.11	1.6	6	99.8	0.1	36.0	17.9	0.1	Peoria Road.....	Capitol.....	Sangamon....	(4)
7.6	0.14	6.0	21	99.9	0.0	26.6	11.9	0.1	.....	.....	.....	(3)
12.8	0.38	8.7	32	99.9	0.0	23.7	13.0	0.1	.....	.....	.....	(3)
14.0	0.27	8.3	41	100	0.0	23.6	15.7	0.0	Lowden's Road..	Nashau.....	Ogle.....	(1)
12.7	0.25	8.3	35	99.9	0.0	24.1	15.7	0.1	..do.....	..do.....	..do.....	(1)
14.0	0.23	8.9	36	99.9	0.0	24.5	15.7	0.1	..do.....	..do.....	..do.....	(1)
13.6	0.38	8.9	35	99.9	0.0	26.2	15.7	0.1	..do.....	..do.....	..do.....	(1)
Soft	0.50	Soft	.....	100	0.0	25.1	12.6	0.0	So. Sixth Street Road.	Woodside....	Sangamon....	(3)
15.0	0.22	10.5	30	100	0.0	23.9	15.0	0.0	Lowden's Road..	Nashau.....	Ogle.....	(1)
7.2	0.05	5.6	22	99.9	0.0	26.1	15.3	0.1	Murphysboro Road.	Carbondale...	Jackson.....	(1)
Soft	1.3	Soft	.....	99.8	0.0	22.8	12.1	0.2	Masonic Home Road.	Sullivan.....	Moultrie....	(3)

[3] Surface treatment.
[4] Mixed miscellaneous residues, used in repairs.

TABLE V—

Laboratory number.	Trade name.	Manufactured by—	Specific gravity at 25°C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. at 25°C.	Brittleness tes at 5°C.
841	Astec Road Binder	U. S. Asphalt Refining Co.	1.038	52	260	290	Over 100	Slightly brittle.
874	Astec Road Binder	..do	1.042	46	265	283	Over 100	..do
875	Astec Road Binder	..do	1.040	47	265	295	Over 100	..do
876	Astec Road Binder	..do	1.040	44	260	290	Over 100	..do
970	Astec Refined Asphalt	..do	1.052	61	280	310	57	Very brittle
972	Astec Bitose	..do	1.021	100	212	234	3	Not brittle
1046	Astec Road Binder	..do	1.023	47	263	298	Over 100	Slightly brittle.
1048	Standard "C"	Standard Oil Co.	0.988	74	280	311	5	Not brittle
1057	Standard Asphalt Macadam Binder "C".	..do	0.982	78	285	325	3	..do
1058	Standard Asphalt Macadam Binder "C".	..do	0.984	81	280	330	3	..do
1067	Standard Paving Filler	..do	0.990	113	280	312	2	..do

[1] Penetration work.
[2] Manufacturer's sample.

TABLE VI—TESTS OF

Laboratory number.	Trade name.	Manufactured by—	Specific gravity at 25°C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. at 25°C.	Brittleness test at 5°C.
1124	Texaco No 96	The Texas Co	.996	53	237	279	47	O K
1138	Astec Surfacing Asphalt	U. S. Asphalt Refining Co., New York, N Y.	1.033	..	255	290	.....	.....
1149	Texaco No. 96	The Texas Co	1.002	51	235	275	55	O. K
1185	Standard Heavy Flux	Standard Oil Co	1.022	45	248	283	Exceeds 100	..do
1264	Texaco No. 32	John Baker, Jr., Otis Building, Chicago, Ill.	1.038	100	228	280	4	Slightly brittle.
1353	Stanolind Paving Asphalt C.	Standard Oil Co., 72 W. Adams St., Chicago, Ill.	1.062	41	237	264	Exceeds 100	O. K
1354	Bermuda Road Asphalt.	Barber Asphalt Paving Co., Maurer, N. J.	1.047	45	202	224	65	..do
1357	.....	Submitted by F. Beyer, Peoria, Ill	1.041	51	262	290	68	..do
1362	Stanolind Paving Asphalt C.	Standard Oil Co., Whiting, Ind.	1.063	44	254	278	Exceeds 100	Brittle
1543	Rocker Pocket Filler	The Texas Co	1.025	98	254	296	4	O. K
1546	Refined Trinidad Lake Asphalt.	Barber Asphalt Paving Co., Chicago, Ill.	1.398	110	234	265	0	Very brittle
1547	Trinidad Lake Asphalt Cement.	..do	1.211	54	208	242	67	Slightly brittle.
1562	80 Penetration Asphalt	Pinal Dome Refining Co., Santa Maria, Cal.	1.031	60	276	312	Exceeds 100	O. K
1563	16 Penetration Asphalt, Cal.	..do	1.074	72	248	288	6	Brittle
1699	Stanolind Paving Asphalt C.	Standard Oil Co	1.056	47	260	295	Exceeds 100	O. K

[1] Manufacturer's sample.
[2] Manufacturer's sample, not enough for complete test.

Concluded.

Penetration at 25°C., 100 gm., 5 sec., in mm.	Evaporation, 5 hours at 163°C.			Bitumen soluble in CS_2, in per cent.	Organic matter insoluble in CS_2, in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
	Loss in per cent.	Penetration of residue in mm.	Change in penetration in per cent.						Road or section.	Township or route.	County.	
14.8	0.27	8.0	46	99.9	0.0	24.1	14.5	0.1	Fieldon Road....	Jerseyville..	Jersey.....	
11.7	0.42	7.6	35	100	0.0	26.4	16.1	0.0	Lowden's Road..	Nashau.....	Ogle.....	(1)
10.9	0.30	7.5	31	99.9	0.0	27.2	15.9	0.1	..do.....	..do.....	..do.....	(1)
11.8	0.33	7.7	35	99.9	0.1	25.2	16.1	0.0	..do.....	..do.....	..do.....	(1)
4.4	0.18	2.5	43	100	0.0	29.8	17.5	0.0	.....	.....	.....	(2)
3.2	1.03	2.0	38	99.9	0.1	38.6	16.6	0.0	.....	.....	.....	(2)
10.0	0.31	7.9	21	99.8	0.0	25.9	15.1	0.2	Lowden's Road..	Nashau.....	Ogle.....	(1)
7.5	0.09	6.9	8	99.0	0.8	24.4	14.4	0.2	Tri City Road....	Stipes.....	St. Clair.....	(5)
10.1	0.21	8.9	12	99.5	0.0	21.1	12.3	0.5	Section A.....	Route 4.....	Peoria.....	(6)
9.4	0.16	8.1	14	99.5	0.1	20.8	12.5	0.4	..do.....	..do.....	..do.....	(6)
5.4	0.02	5.1	6	97.0	2.2	29.4	14.8	0.8	.....	.....	.....	

[5] Used in repairs.
[6] Bituminous macadam shoulders.

ASPHALT—1915.

Penetration at 25°C., 100 gm., 5 sec., in mm.	Evaporation, 5 hours at 163 C.			Total bitumen or per cent soluble in CS_2.	Organic matter insoluble in CS_2, in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
	Loss in per cent.	Penetration of residue in mm.	Change in penetration in per cent.						Road.	Township.	County.	
8.3	0.43	6.1	27	99.8	0.0	22.4	10.6	0.2	.....	.....	.....	(1)
25.2	0.34	.....	.....	99.9	0.0	23.2	12.2	0.1	.....	.....	.....	(1)
9.3	0.27	6.4	31	99.7	0.2	19.9	10.5	0.1	.....	.....	.....	(2)
12.6	0.21	11.8	7	99.9	0.0	22.9	13.2	0.1	.....	.....	.....	(1)
2.8	0.25	1.3	53	99.6	0.0	36.3	15.0	0.4	.....	.....	.....	(1)
11.7	0.28	7.8	26	99.8	0.1	21.2	15.4	0.1	.....	.....	.....	(1)
13.8	2.2	6.3	54	96.6	0.8	18.1	10.1	2.6	Sections 27 and 28 road south of Pontiac.....	Pontiac.....	Livingston...	
13.8	0.9	8.6	38	99.8	0.0	24.1	12.9	0.2	Section A, route 4..	.....	Peoria.....	
9.6	0.31	4.7	51	99.8	0.1	24.0	16.9	0.1	.....	.....	.....	(1)
2.9	0.2	1.9	34	99.8	0.2	32.6	16.3	0.0	Exeter bridge.....	.....	Scott.....	
0.3	0.5	0.0	.....	58.3	5.6	35.5	8.8	36.1	Thatcher road.....	Proviso.....	Cook.....	
5.4	2.0	1.7	68	75.6	2.0	24.3	7.2	22.4	..do.....	..do.....	..do.....	
8.9	0.1	5.4	39	99.5	0.0	22.7	14.2	0.5	.....	.....	.....	(1)
2.1	0.16	1.5	29	99.2	0.0	35.4	19.9	0.8	.....	.....	.....	(1)
8.8	0.23	4.3	51	99.9	0.0	23.7	15.4	0.1	O'Fallon job.....	Shiloh Valley	St. Clair.....	

TABLE VI—

Laboratory number.	Trade name.	Manufactured by—	Specific gravity at 25°C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. at 25°C.	Brittleness test at 5°C.
1727	Stanolind Paving Asphalt C.	Standard Oil Co., 72 W. Adams St., Chicago.	1.064	41	255	285	Exceeds 100	O. K.....
1740	Texaco No. 96.....	The Texas Co.....	1.019	54	245	285	32	..do.....
1753	Sarco Expansion Joint Filler.	Standard Aspnalt & Rubber Co., Chicago, Ill.	.986	.....	.....	.....	.....	.....
1757	Asphalt for Rocker Pocket Filler.	.....	1.013	81	243	280	5	Slightly brittle.
1768	Standard Macadam Asphalt Binder B.	Standard Oil Co.....	.990	78	283	325	4	O. K.....
1789	Standard Macadam Asphalt Binder B.	..do.....	.985	78	283	328	4	..do.....
1770	Standard Paving Filler.	..do.....	.983	131	273	315	2	..do.....
1771	Stanolind Paving Asphalt C.	..do.....	1.056	52	254	294	85	Very brittle....
1778	Sarco No. 150.....	Standard Asphalt & Rubber Co.	.980	65	256	295	6.5	O. K.....

[1] Mannfacturer's sample.

TABLE VII—TESTS OF

Laboratory number.	Trade name.	Submitted by—	Specific gravity at 25°C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. at 25°C.	Brittleness test at 5°C.
1833	Stanolind Asphalt "C"	B. H. Piepmeier, State Highway Department.	1.041	49	266	297	Over 100	O. K.....
1884	Sarco Asphalt for Bridge Rocker Pockets.	Connelly & Dunning, Chicago, Ill.	0.982	84	262	296	3	Very good.....
1912	Magnolia Mexican Penetration Macadam Asphalt.	J. F. McGurk, Chicago, Ill.	1.036	52	234	302	74	O. K.....
2000	Stanolind Paving Asphalt "C".	Booth, Nicholson & Gilchrist, Gardner, Ill.	1.066	47	248	284	Exceeds 100	..do.....
2015	Stanolind Paving Asphalt "C".....	I. E. Scott, O'Fallon, Ill..	1.060	47	250	288	Exceeds 100	Slightly brittle.
2044	Magnolia AA for Bituminous Macadam.	J. F. McGurk, Chicago, Ill.	1.030	44	255	298	Exceeds 100	O. K.....
2045	Magnolia A for Bituminous Concrete Pavement.	..do.....	1.042	52	266	296	Exceeds 100	..do.....

Concluded.

Penetration at 25°C., 100 gm., 5 sec., in mm.	Evaporation, 5 hours at 163°C.			Total bitumen or per cent soluble in CS_2.	Organic matter insoluble in CS_2 in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
	Loss in per cent.	Penetration of residue in mm.	Change in penetration in per cent.						Road.	Township.	County.	
18.3	0.3	9.3	49	99.8	0.0	22.5	14.8	0.2	.....	.....	.....	(1)
8.9	1.0	6.2	30	99.9	0.0	27.8	12.9	0.1	.....	Carbondale...	.....	
5.8	.....	.....	.....	99.6	0.4	28.2	11.8	0.0	Fitzgerald bridge, rocker pocket	.....	Cook.....	(2)
2.0	0.1	1.8	10	99.8	0.1	34.6	14.9	0.1	.....	.....	..do.....	
12.0	0.1	9.6	20	97.7	1.2	23.1	12.0	1.1	For rocker pockets.	.....	..do.....	
8 8	0.06	6.9	22	99.6	0.0	19.1	11.5	0.4	..do.....	.....	..do.....	
4.5	0.05	3.7	18	99.7	0.0	27.4	13.0	0.3	..do.....	.....	..do.....	
6.7	0.23	4.8	28	99.8	0.1	22.6	13.8	0.1	..do.....	.....	..do.....	
14.4	0.09	11.2	22	99.6	0.0	22.9	10.7	0.4	..do.....	.....	..do.....	

[2] Not enough for complete test.

ASPHALTS—1916.

Penetration in 1-100 of a gm. 25°C., 100 gm. weight, 5 seconds.	Evaporation, 5 hours at 163°C.			Total bitumen in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
	Loss in per cent.	Penetration of residue in 1-100 cm.	Change in penetration in per cent.						Road.	Township.	County.	
88	0.14	63	28	99.8	0.1	26.7	15.0	0.1	.....	.....	.....	Manufacturer's sample from Standard Oil Co.
133	1.40	124	7	99.4	0.2	22.1	11.4	0.4	Section C.....	.....	Stark.....	Manufactured by Standard Asphalt & Rubber Co., Chicago, Ill.
84	0.30	60	28	99.8	0.1	27.1	16.5	0.1	.....	.....	.....	Producer's sample.
92	0.05	65	30	99.8	0.0	23.3	14.4	0.2	.....	.....	.....	Preliminary sample from Standard Oil Co.
115	0.29	60	48	99.8	0.1	24.6	15.6	0.1	Shiloh-O'Fallon.	.....	St. Clair....	Material furnished by Standard Oil Co.
100	0.29	70	30	99.9	0.0	28.7	16.4	0.1	.....	.....	.....	Manufacturer's sample from Magnolia Petroleum Co., Beaumont, Tex.
90	0.29	62	31	99.9	0.0	27.4	16.0	0.1	.....	.....	.....	Manufacturer's sample from Magnolia Petroleum Co., Beaumont, Tex.

TABLE VII—

Laboratory number.	Trade name.	Submitted by—	Specific gravity at 25°C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. at 25°C.	Brittleness test at 5°C.
2046	Magnolia B for Bituminous Concrete Pavement.	J. F. McGurk, Chicago, Ill.	1.048	57	271	302	Exceeds 100	O. K.
2054	Mexican Asphalt to meet specifications C.	John A. McGarry & Co., Chicago, Ill.	1.045	49	286	320	Exceeds 100	..do.
2171	Stanolind Paving Asphalt "C".	H. B. Pope, Morris, Ill..	1.061	44	248	288	Exceeds 100	..do.
3129	Asphalt for Bridge Rocker Pockets.	M. M. Small, Moline, Ill.	0.961	....	256	285	6	Good.
3135	Stanolind Paving Asphalt "C".	H. B. Pope, Morris, Ill...	1.055	46	275	311	Exceeds 100	O. K., slightly brittle.
3133	California Asphalt....	B. H. Piepmeier, State Highway Department.	1.022	46	266	306	66	Very brittle....
3137	Asphalt.....	..do.....	0.993	55	267	306	15	Good.
3159	Bermudez Road Asphalt.	Laboratory of Barber Asphalt Paving Co., Maurer, N. J.	1.049	49	201	236	59	O. K., slightly brittle.
3169	Asphalt for Bridge Rocker Pockets.	O. F. Goeke, Moline. Ill..	0.992	122	285	316	2	O. K.
3220	Asphalt for Bridge Rocker Pockets.	..do.....	0.983	84	276	310	3½	..do.
3223	Asphalt.....	H. B. Pope, Morris, Ill...	1.055	47	249	293	Exceeds 100	O. K., slightly brittle.
3244	Standard Paving Asphalt Filler.	Central States Bridge Co., Indianapolis, Ind.	0.987	125	280	312	2	Good.
3299	Asphalt Filler.....	A. R. Russell, DeKalb, Ill.	.....	134	.....	.....	.....	.....
3311	Stanolind Paving Asphalt "C".	H. B. Pope, Morris, Ill...	1.058	48	244	288	Exceeds 100	O. K., slightly brittle.
3312	Stanolind Paving Asphalt "C"	Standard Oil Co., Whiting, Ind.	1.062	50	245	289	Exceeds 100	..do.
3341	Bermudez Road Asphalt.	P. R. Genzmer, Lombard, Ill.	1.042	46	194	234	66	..do.
3377	Bermudez Road Asphalt.	..do.....	1.050	47	195	230	58	..do.
3384	Asphalt for Bridge Rocker Pockets.	O. F. Goeke, Moline, Ill..	1.048	69	267	316	16	Very brittle....
3411	Bermudez Road Asphalt.	P. R. Genzmer, Lombard, Ill.	1.051	48	193	230	48	O. K., slightly brittle.
3423	Bermudez Road Asphalt.	..do.....	1.046	46	186	228	Exceeds 100	..do.
3430	Asphalt for Bridge Rocker Pockets.	J. H. Reed, County Superintendent of Highways, Cambridge, Ill.	0.983	75	257	290	7	O. K.
3438	Asphalt for Bridge Rocker Pockets.	W. M. Slater, County Superintendent of Highways, Wyoming, Ill.	0.983	76	260	290	7	..do.

Continued.

Penetration in 1-100 of a cm. 25°C., 100 gm. weight, 5 seconds.	Evaporation, 5 hours at 163°C.			Total bitumen in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
	Loss in per cent.	Penetration of residue in 1-100 cm.	Change in penetration in per cent.						Road.	Township.	County.	
68	0.12	46	32	99.9	0.0	29.3	17.1	0.1	.....	.....	.....	Manufacturer's sample from Magnolia Petroleum Co., Beaumont, Tex.
92	0.08	56	39	99.9	0.0	27.1	13.8	0.1	Section D Route 14.	.....	Iroquois....	
120	0.28	60	50	99.8	0.1	22.3	14.2	0.1	Section B, Routes 2 and 3.	.....	Grundy....	Material furnished by Standard Oil Co.
122	0.25	118	3	99.1	0.5	24.5	11.6	0.4	.....	.....	Mercer.....	For bridges.
112	0.25	48	57	99.9	0.0	22.8	13.0	0.1	Section C, Route 1	.....	Grundy....	Material furnished by Standard Oil Co.
120	0.08	74	38	99.8	0.1	13.1	9.7	0.1	.....	Mattoon..	Coles.....	Repairs on bituminous macadam.
80	0.02	66	17	99.9	0.0	25.5	12.4	0.1	.....	..do.....	..do.....	Repairs on bituminous macadam.
136	1.81	102	25	96.2	1.5	20.0	9.8	2.3	Section C.....	.....	DuPage....	Preliminary sample from Barber Asphalt Paving Co.
37	0.07	28	24	98.9	0.6	30.0	15.0	0.5	.....	.....	Henry.....	Preliminary sample from Standard Oil Co. for use on Colona Br.
92	....	77	16	99.5	0.3	25.0	12.9	0.2	.....	.....	..do.....	Preliminary sample of material proposed for use on Colona Br.
115	0.52	72	37	99.7	0.1	23.7	14.4	0.2	Section C.....	.....	Grundy....	Material furnished by Standard Oil Co.
38	0.06	21	45	99.2	0.8	29.0	14.6	0.0	..do.....	.....	Vermilion..	Material from Standard Oil Co. proposed for use on Br. floors.
32	0.10	27	16	98.9	0.6	....	....	0.5	.....	.....	DeKalb....	Carbenes 0.5 per cent.
114	0.24	64	44	99.9	0.0	24.4	15.2	0.1	Section C.....	.....	Grundy....	Material furnished by Standard Oil Co.
103	0.22	65	37	99.9	0.1	27.9	16.0	0.0	.....	.....	.....	Preliminary sample.
165	1.45	94	43	96.6	1.5	19.1	10.1	1.9	Section C.....	York.....	DuPage....	Material furnished by Barber Asphalt Paving Co.
124	1.17	78	37	96.1	1.4	19.9	9.5	2.5	..do.....	..do.....	..do.....	Material furnished by Barber Asphalt Paving Co.
14	0.0	12	14	99.8	0.2	26.3	20.0	0.0	.....	.....	Henry.....	Material from Standard Oil Co. proposed for use on Colona Bridge.
160	2.80	72	55	96.3	1.1	18.6	9.6	2.6	Section C.....	York.....	DuPage....	Material furnished by Barber Asphalt Paving Co.
156	2.07	84	46	97.1	1.0	19.6	9.7	1.9	..do.....	..do.....	..do.....	Material furnished by Barber Asphalt Paving Co.
118	0.13	98	17	99.1	0.2	23.3	10.6	0.7	.....	Annawan	Henry.....	Barker Bridge.
120	0.09	100	17	99.0	0.5	23.0	11.0	0.5	.....	.....	Stark.....	County bridges.

TABLE VII—

Laboratory number.	Trade name.	Submitted by—	Specific gravity at 25°C.	Melting point in °C.	Flash point in °C.	Burning point in °C.	Ductility in cm. at 25°C.	Brittleness test at 5°C.
3513	Asphalt for Bridge Floor.	J. D. Russell, County Superintendent of Highways, Oswego, Ill.	0.993	136	265	316	4	O. K.....
3583	Texaco Asphalt.....	Harold Andrew, Watseka, Ill.	0.999	62	260	298	76	..do.....
3590	Asphalt for Bridge Rocker Pockets.	O. L. Gearhart, Galesburg, Ill.	1.405	142	198	260	0	Very hard and brittle.....
3618	Asphalt for Bridge Rocker Pockets.	..do.....	0.989	121	268	323	2	O. K .....
3619	Asphalt for Bridge Rocker Pockets.	..do.....	0.992	114	246	290	2	..do.....
3673	Trinidad Lake Asphalt.	H. C. Peterson, Park Ridge, Ill.	1.404	110	210	256	Too hard	Very brittle....
3675	Asphalt Paving Cement.	..do.....	1.245	59	212	252	55	O. K., slightly brittle.....
3684	Bermudez Road Asphalt.	H. W. Hartmann, Ancona, Ill.	1.050	47	192	230	78	..do.....

TABLE VIII—TESTS

Laboratory number.	Trade name.	Manufactured by—	Specific gravity at 25°C.	Melting point in °C.	Time of float test at 50°C.	Bitumen soluble in CS_2 in per cent.	Free carbon in per cent.	Ash in per cent.	Brittleness at 5°C.
	1913								
390	Crude tar.....	Cairo Gas Co.....	1.205	Soft	10 sec.....	82.7	17.2	0.1	Soft.
393	.....	.....	1.221	Soft	30 sec.....	81.9	18.0	0.1	Soft.
424	Crude Tar.....	H.E. Brown, Geneseo, Ill.	1.121	Liquid	Liquid.....	.....	.....	....	Liquid.
	1914								
528	Paving Pitch.....	Barrett Mfg. Co.....	1.32	65	.....	.....	.....	....	Brittle.
1056	Tarvia X.....	..do.....	1.248	35	1 min., 40 sec.	76.2	23.6	0.2	Not brittle.

Concluded.

Penetration in 1-100 of a cm. 25°C., 100 gm. weight, 5 seconds.	Evaporation, 5 hours at 163°C.			Total bitumen in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Bitumen insoluble in 86°B. naphtha in per cent of total bitumen.	Fixed carbon in per cent.	Ash in per cent.	Where used.			Remarks.
	Loss in per cent.	Penetration of residue in 1-100 cm.	Change in penetration in per cent.						Road.	Township.	County.	
33	0.08	29	12	99.5	0.4	30.4	14.2	0.1	.....	.....	Kendall....	Material furnished by Standard Oil Co. for carpet coat on bridge floors.
103	3.0	76	26	99.9	0.0	23.9	11.9	0.1	Section D....	.....	Iroquois....	Material manufactured by the Texas Co.
0	0.86	....	....	44.2	19.6	15.2	7.9	36 2	.....	.....	.....	Unsuitable for this work.
31	0.10	20	35	99.7	0.1	30.6	15.1	0.2	.....	.....	.....	Manufactured by Standard Oil Co.
33	0.17	21	36	99.8	0.1	25.7	12.6	0.1	.....	.....	.....	Manufactured by The Pioneer Asphalt Co.
2	0.76	....	....	60.0	3.5	39.6	7.5	36.5	Rand.....	Section 2, Route 5	Cook (bond issue)....	Material furnished by Barber Asphalt Paving Co. used fluxed with 3674 (see road oils).
46	1.07	28	39	74.9	2.6	28.8	8.1	22.5	..do.....	..do.....	..do.....	
115	2.65	68	41	95.6	1.0	19.6	9.0	3.4	Section 1, Route 16.	.....	Livingston.	Material furnished by Barber Asphalt Paving Co.

OF TARS—1913–1914.

Distillation.								Pitch at 315°C. in per cent by volume.	Where used—			Remarks.
Up to 110°C.		110°C–170°C.		170°C–270°C.		270°C–315°C.			Road.	Township.	County..	
Water in per cent by volume.	First light oils in per cent by volume.	Second light oils in per cent by volume.	Solids in per cent by volume at 25°C.	First heavy oils in per cent by volume.	Solids in per cent by volume at 25°C.	Second heavy oils in per cent by volume	Solids in per cent by volume at 25°C.					
1.6	1.2	2.0	0	20.8	5	8.0	50	66.4	.....	.....	.....	Submitted by City Gas Co., Cairo, Ill.
0	0	1.2	0	22.0	10	7.6	50	69.2	.....	.....	.....	Obtained by distilling No. 390 to 110°C.
28.4	4.0	0.4	0	16.8	10	15.6	30	34.8	.....	.....	.....	
....	....	....	....	....	....	....	....	....	.....	.....	.....	Pitch meeting Chicago specifications.
0.4	0.4	0.4	100	6.4	40	13.6	20	78.8	Fourth Street..	Capitol.	Sangamon .	

TABLE IX—TESTS

Laboratory number.	Trade name.	Manufactured by—	Specific gravity at 25°C.	Specific viscosity at 50°C.	Time of float test in seconds at 32°C.	Bitumen soluble in CS_2 in per cent.	Free carbon in per cent.	Ash in per cent.	Fixed carbon in per cent.
1142	Lewis Light Road Tar.	F. J. Lewis Mfg. Co.	1.206	110	54	84.2	15.7	0.1	16.8
1143	Tarvia A	Barrett Mfg. Co.	1.222	.....	109	85.2	14.7	0.1	24.6
1144	Tarvia B	..do.	1.137	3.7	.....	96.1	3.8	0.1	14.0
1152	Ugite-3	United Gas Imp. Co., Philadelphia, Pa.	1.162	.....	210	98.1	1.8	0.1	21.3
1166	Refined Coal Tar	.....	.....	.....	.....	38.0	15.5	46.5	14.5
1208	Refined Coal Tar	F. J. Lewis Mfg. Co., Chicago, Ill.	1.213	.....	63	82.2	17.8	0.0	28.6
1474	Tarvia B	Barrett Mfg. Co.	1.145	3.1	.....	95.3	4.6	0.1	12.7
1481	Tarvia B	..do.	1.145	4.3	.....	95.1	4.8	0.1	12.9
1797	.....	.....	.....	.....	.....	.....	16.8	.....	.....

OF TARS—1915.

Distillation.							Where used.			Remarks.
Up to 110°C.		110°C.-170°C.		170°C.-315°C.		Pitch at 315°C. in per cent by volume.	Road.	Township.	County.	
Water in per cent by volume.	First light oils per cent by volume.	Second light oils in per cent by volume.	Solids per cent by volume at 25°C.	Heavy oils in per cent by volume.	Solids in per cent by volume at 25°C.					
2.0	Trace	0.4	.....	30.9	.....	68.7	.....	.....	.....	Straight run coal tar. Manufacturers sample.
0.0	Trace	0.6	.....	24.0	25	75.4	.....	.....	.....	Straight run coal tar. Manufacturers sample.
1.2	1.2	1.0	0.0	39.6	2	57.0	.....	.....	.....	Water gas tar. Manufacturers sample.
0.0	0.0	Trace	.....	24.4	0.0	75.6	.....	.....	.....	Manufacturers sample.
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	The ash consists of fine sand passing 1-16 inch sieve.
0.0	Trace	Trace	.....	26.8	0.0	73.2	.....	.....	Logan.....	
Trace	0.2	1.2	0.0	40.0	0.0	58.6	.....	Rockford.	Winnebago	
Trace	0.4	2.0	0.0	38.4	0.0	59.2	Fair Grounds	.....	Sangamon.	
.....	.....	.....	.....	.....	.....	.....	Code Br.....	Bradford.	Stark.....	Submitted for rocker pocket filler.

TABLE X—1916—TESTS OF BITUMINOUS EXPANSION JOINTS.

Laboratory number.	Trade name.	Manufactured by—	Submitted by—	Thickness in inches.	Bitumen soluble in carbon disulphide in per cent.	Organic matter insoluble in carbon disulphide in per cent.	Mineral matter (ash) in per cent.	Remarks.
1917	Soft Expansion Joint	H. W. Johns Asbestos Co., 208 N. Fifth Av., Chicago, Ill.	H. W. Johns Asbestos Co., 208 N. Fifth Av., Chicago, Ill.	½	69.2	23.9	6.9	Flax felt with tar and mineral matter.
1918	Hard Expansion Joint	..do	..do	½	76.4	22.2	1.4	Flax felt with tar and mineral matter.
1919	Pioneer Expansion Joint Compound No. 1.	The Pioneer Asphalt Co., Lawrenceville, Ill.	The Pioneer Asphalt Co., Lawrenceville, Ill.	½	95.9	3.2	0.9	Asphalt with reinforcement of jute mesh fabric.
1920	Pioneer Expansion Joint Compound No. 2.	..do	..do	½	98.6	0.0	1.4	Asphalt only.
1921	Pioneer Expansion Joint Compound No. 3.	..do	..do	½	72.7	6.9	20.4	Asphalt with jute fibre and mineral matter.
1922	Carey Elastite Expansion Joint, "The Sandwich Joint"	The Philip Carey Co., Cincinnati, Ohio.	The Philip Carey Co., Cincinnati, Ohio.	½	87.0	12.1	0.9	Asphalt with felt and sawdust.
1923	Barrett Expansion Joint	The Barrett Mfg. Co., Chicago, Ill.	The Barrett Mfg. Co., Chicago, Ill.	½	36.7	23.5	39.8	Tar with limestone dust and organic filler.
1994	Ideal Expansion Joint	The Waring-Underwood Co., Commercial Trust Building, Philadelphia, Pa.	The Waring-Underwood Co., Commercial Trust Building, Philadelphia, Pa.	½	99.4	0.3	0.3	Asphalt with cloth fabric.
2022	Barrett Expansion Joint	The Barrett Mfg. Co., Chicago, Ill.	P. C. McArdle, Superintending Engineer, Danville, Ill.	½	37.6	15.9	46.5	Tar with limestone dust and organic filler.
2077	"Genasco" Asphalt Expansion Joint.	The Barber Asphalt Paving Co., Philadelphia, Pa.	The Barber Asphalt Paving Co., Philadelphia, Pa.	½	97.5	0.1	2.4	Asphalt only.
2120	Pittsburgh Paving Joint		Asbestos Protected Metal Co., 231 Insurance Exchange Building, Chicago, Ill.	½	98.8	0.5	0.7	Asphalt only.
2166	Elastite Expansion Joint	The Philip Carey Co., Lockland, Ohio.	G. A. Quinlan, County Superintendent of Highways, Chicago, Ill.	½	85.4	13.2	1.4	Asphalt with felt surface and saw dust filler.

38	Sarco Mineral Rubber Expansion Joint with Mushroom Top	Standard Asphalt & Rubber Co., 208 S. LaSalle St., Chicago, Ill.	Standard Asphalt & Rubber Co....	½	75. 9	1. 6	22. 5	Asphalt joint with felt facing and mushroom top. The filler consists of limestone and sawdust.
3523	Bituminous Expansion Joint.....	.....	Hoopeston Lumber & Coal Co., Hoopeston Ill.	$\frac{3}{16}$	31. 5	29. 9	38. 6	Asphalt with fibre and inorganic filler.

TABLE XI—TESTS OF

Laboratory number.	Bricks sold or manufactured by—	Dimension of bricks in inches.	Specific gravity.	Absorption in per cent.
689	Alton Brick Co	3½x3½x8½	2.21	1.8
700	Clinton, Indiana, Brick Co	3½x3½x9½	2.37	3.3
743	Clinton, Indiana, Brick Co	..do	2.37	2.1
744	Clinton, Indiana, Brick Co	..do	2.37	1.9
745	Clinton, Indiana, Brick Co	..do	2.37	1.6
746	Clinton, Indiana, Brick Co	..do	2.37	2.3
747	Clinton, Indiana, Brick Co	..do	2.37	1.7
748	Clinton, Indiana, Brick Co	..do	2.37	1.6
749	Clinton, Indiana, Brick Co	..do	2.37	6.0
750	Clinton, Indiana, Brick Co	..do	2.37	2.8
795	Albion Vitrified Brick Co	3½x4x8½	2.35	1.9
817	Murphysboro Paving Brick Co	3½x3½x8½	2.30	1.3
818	Murphysboro Paving Brick Co	..do	2.29	1.6
819	Murphysboro Paving Brick Co	2½x3½x8½	2.32	2.2
820	Murphysboro Paving Brick Co	..do	2.32	1.9
823	Albion Shale Brick Co	3½x4x8½	2.14	2.1
828	Martinsville, Indiana, Brick Co	3½x3½x8½	2.27	1.6
838	Danville Brick Co	3½x4x8½	2.17	2.5
839	Danville Brick Co	..do	2.15	1.6
851	Murphysboro Paving Brick Co	3½x3½x8½	2.31	1.8
852	Murphysboro Paving Brick Co	..do	2.33	2.8
855	Purington Paving Brick Co., Galesburg	3½x3½x8½	2.30	0.6
890	Purington Paving Brick Co., Galesburg	3½x4x8½	2.35	1.0
909	Martinsville, Indiana, Brick Co	3½x3½x8½	2.34	4.7
917	Terre Haute, Indiana, Vitrified Brick Co	3½x4x8½	2.30	3.5
931	Albion Shale Brick Co	3½x4x8½	2.38	4.0
938	Albion Vitrified Brick Co	3½x4x8½	2.40	2.7
979	Clinton, Indiana, Brick Co	3½x3½x9½	2.45	1.7
987	Alton Brick Co	3½x4x8½	2.36	2.7
995	Albion Vitrified Brick Co	3½x4x8½	2.41	1.9
996	Albion Vitrified Brick Co	..do	2.42	1.5
997	Albion Vitrified Brick Co	..do	2.40	1.2
1022	F. R. Carter, Peoria	2½x4x8½	2.43	0.9
1029	Terre Haute, Indiana, Vitrified Brick Co	3½x4x8½	2.32	2.0
1034	Murphysboro, Vitrified Brick Co	3½x3½x8½	2.36	1.8
1035	Albion Vitrified Brick Co	3½x4x8½	2.42	2.7
1037	F. R. Ca ter, Peoria	2½x4x8½	2.43	1.1
1040	Albion Vitrified Brick Co	3½x4x8½	2.40	1.7
1041	Albion Vitrified Brick Co	..do	2.41	1.8
1052	Albion Vitrified Brick Co	..do	2.44	1.9
1053	Albion Vitrified Brick Co	..do	2.44	1.7
1054	Albion Vitrified Brick Co	..do	2.40	2.3
1059	Clinton, Indiana, Brick Co	3½x3½x9	2.39	3.8
1060	Clinton, Indiana, Brick Co	..do	2.40	5.7
1061	Albion Vitrified Brick Co	3½x4x8½	2.40	1.6
1063	Danville Brick Co	3½x4x9	2.43	2.1
1069	Danville Brick Co	..do	2.34	6.0
1070	Danville Brick Co	..do	2.36	3.2
1071	Danville Brick Co	..do	2.44	2.5
1085	Danville Brick Co	..do	2.35	4.2
1086	Danville Brick Co	..do	2.34	4.2
1087	Danville Brick Co	..do	2.37	3.7
1088	Danville Brick Co	..do	2.37	3.7
1089	Danville Brick Co	..do	2.37	5.2
1095	Danville Brick Co	3½x4x8½	2.37	2.8
1096	Danville Brick Co	..do	2.37	1.85
1097	Danville Brick Co	..do	2.37	1.25
1098	Danville Brick Co	..do	2.37	1.15
1099	Danville Brick Co	..do	2.37	2.1

NOTES.—* Bricks broken in rattler.
† Not fair sample. Bricks taken from shipment to guide in culling poor bricks.
§ Bricks added in rattler.
[1] Tested in rattler with No. 744.
[2] Tested in rattler with No. 743.
[3] Tested in rattler with No. 746.

PAVING BRICKS—1914.

Rattler test—Loss in per cent by weight.												
Brick No. 1.	Brick No. 2.	Brick No. 3.	Brick No. 4.	Brick No. 5.	Brick No. 6.	Brick No. 7.	Brick No. 8.	Brick No. 9.	Brick No. 10.	Average loss.	Remarks.
22.0	16.0	16.8	16.5	15.1	21.0	19.5	18.4	20.1	17.5	18.3	Dunn wire-cut lug block.
20.2	21.4	20.6	23.4	19.3	24.6	26.7	27.2	30.4	25.3	23.9	Dunn wire-cut lug block.
31.0	27.5	27.9	24.0	27.4	(1)	(1)	(1)	(1)	(1)	27.6	Dunn wire-cut lug block.
24.7	26.7	25.9	29.4	29.7	(2)	(2)	(2)	(2)	(2)	27.3	Dunn wire-cut lug block.
27.4	22.2	26.7	25.2	24.1	(3)	(3)	(3)	(3)	(3)	25.1	Dunn wire-cut lug block.
30.6	32.2	25.4	22.4	22.9	(4)	(4)	(4)	(4)	(4)	26.7	Dunn wire-cut lug block.
23.6	18.2	23.5	30.0	16.6	(5)	(5)	(5)	(5)	(5)	22.4	Dunn wire-cut lug block.
25.3	32.5	40.7	25.2	23.7	(6)	(6)	(6)	(6)	(6)	29.5	Dunn wire-cut lug block.
35.3	25.5	31.3	22.0	23.4	(7)	(7)	(7)	(7)	(7)	27.5	Dunn wire-cut lug block.
24.4	28.6	25.9	40.7	26.2	(8)	(8)	(8)	(8)	(8)	29.2	Dunn wire-cut lug block.
19.2	21.1	20.5	21.3	19.2	21.4	19.0	20.7	18.0	21.5	20.2	Repressed bricks.
19.5	16.8	19.0	20.2	20.4	19.9	19.1	22.5	27.4	18.3	20.3	Repressed bricks.
23.1	20.9	26.3	25.4	20.7	16.5	18.6	19.0	29.3	30.0	23.9	Repressed bricks.
*31.0	20.0	*28.0	26.1	*29.4	22.5	*26.2	*21.0	*17.6	*23.2	24.5	Repressed bricks.
20.8	19.3	20.4	21.8	*25.7	13.9	15.2	*33.8	18.8	*16.3	20.6	Repressed bricks.
18.1	19.6	19.6	16.7	18.3	15.6	15.2	11.5	15.8	17.6	16.8	Repressed bricks.
16.8	18.2	17.7	18.6	16.9	18.1	15.0	17.3	17.2	14.0	17.0	Repressed bricks.
16.5	15.2	19.3	17.7	18.3	18.6	20.6	17.5	22.8	17.5	18.4	Wire-cut lug blocks.
20.6	18.2	16.5	*24.3	20.5	18.1	*24.5	15.5	*24.4	*18.4	20.1	Repressed bricks.
15.2	16.6	15.8	12.8	16.5	18.3	29.8	22.2	15.3	15.6	17.8	Repressed bricks.
21.1	16.4	24.5	16.7	16.9	23.1	19.5	16.9	*20.6	15.5	19.1	Repressed bricks.
16.7	21.9	20.6	17.2	18.9	17.5	17.9	17.0	18.5	18.0	18.4	Repressed bricks.
21.0	18.8	17.8	18.9	21.9	15.7	18.9	19.8	20.0	17.2	19.0	Repressed bricks.
19.0	22.5	26.6	18.7	25.0	23.1	17.4	27.2	28.0	23.0	23.0	Repressed bricks.
18.4	22.4	17.1	19.0	20.0	20.2	16.1	24.0	24.3	21.6	20.3	Wire-cut blocks.
24.9	21.6	23.3	18.6	17.3	19.3	*42.1	27.5	14.3	23.5	23.2	Repressed bricks. †
26.0	21.7	19.6	*35.8	25.5	25.7	20.2	*33.2	18.4	18.0	24.4	Repressed bricks.
25.3	23.5	27.0	18.9	22.1	21.6	22.2	19.8	18.8	23.7	22.3	Dunn wire-cut lug blocks.
21.2	21.1	19.7	19.7	18.4	26.1	28.0	19.5	19.4	21.7	21.3	Dunn wire-cut lug blocks. †
21.1	20.4	21.2	22.8	26.9	21.1	23.1	31.0	24.6	21.4	23.3	Repressed bricks.
22.0	21.2	23.1	21.9	25.3	25.3	22.3	17.4	19.6	31.8	23.0	Repressed bricks.
21.9	28.2	24.3	34.5	20.3	25.2	29.1	22.8	25.9	23.0	25.5	Repressed bricks.
25.6	*45.9	27.4	29.3	23.4	24.7	14.8	26.9	*35.8	31.3	28.5	Repressed bricks.
16.7	20.2	*21.7	19.1	*20.8	*28.4	17.2	15.9	§	§	20.0	Wire-cut blocks.†
*23.4	20.5	17.4	21.2	20.8	16.5	*22.4	18.7	16.9	*21.9	20.0	Wire-cut blocks.
21.8	20.3	22.2	19.0	22.0	21.4	17.8	19.6	19.0	23.4	20.6	Repressed bricks.
21.1	29.3	23.0	20.1	38.5	28.3	22.8	25.1	26.5	28.3	26.3	Repressed bricks.
20.0	24.7	20.3	20.9	16.5	19.2	23.6	15.4	17.6	17.3	19.6	Repressed bricks.
20.7	20.3	17.4	20.5	16.6	22.4	15.8	18.0	25.8	18.6	19.6	Repressed bricks.
18.1	21.1	24.7	22.9	16.4	24.0	23.5	24.8	25.0	18.4	21.8	Repressed bricks.
23.1	21.7	22.7	21.9	29.1	25.9	17.8	26.3	24.0	20.8	23.3	Repressed bricks.
26.8	17.8	23.8	21.3	19.5	18.4	19.7	19.2	19.3	19.4	20.5	Repressed bricks.
27.0	28.6	23.2	23.1	23.0	22.2	22.5	23.9	19.7	23.2	23.6	Dunn wire-cut lug blocks.
18.6	19.4	21.3	20.1	17.9	26.8	24.7	16.4	29.6	22.1	21.7	Dunn wire-cut lug blocks.
19.2	18.8	21.8	22.9	16.4	22.8	18.1	20.9	21.8	19.8	20.2	Repressed bricks.
16.7	19.3	15.8	19.5	*26.1	15.2	19.9	14.5	16.8	18.0	18.2	Wire cut bricks.
25.9	24.5	30.4	22.8	26.6	18.5	15.5	17.9	20.6	21.1	22.4	Wire cut bricks. †
24.3	22.4	16.0	16.3	16.5	14.8	17.9	20.0	21.0	16.5	18.6	Wire-cut bricks. †
20.4	15.3	18.4	24.3	19.5	19.1	22.1	18.2	16.5	17.9	19.2	Wire-cut bricks. †
22.5	19.5	14.8	17.7	18.6	*23.4	14.5	15.9	17.1	19.4	18.3	Wire-cut bricks. †
22.2	20.5	22.7	23.1	24.1	22.7	22.4	22.7	19.9	*26.0	22.6	Wire-cut bricks. †
*21.4	*27.3	21.2	*20.2	14.7	*29.0	17.9	*22.2	18.7	19.4	21.2	Wire-cut bricks. †
20.0	15.4	*25.4	14.9	16.4	17.3	*20.9	16.9	21.4	16.3	18.5	Wire-cut bricks. †
*24.1	14.3	*21.6	19.5	15.6	17.3	*34.8	*35.8	16.4	*19.8	21.9	Wire-cut bricks. †
*18.2	18.3	21.8	*20.4	20.9	16.3	22.5	24.4	18.5	*24.1	20.5	Wire-cut bricks. †
16.8	18.6	*23.3	25.5	18.7	*23.1	23.7	*32.1	*26.6	19.7	22.7	Wire-cut bricks. †
18.6	18.2	17.8	*29.5	19.7	*25.9	*14.9	*23.9	18.4	16.1	20.3	Wire-cut bricks. †
15.1	*20.4	*21.6	14.9	*23.1	20.9	18.7	17.0	14.3	*19.2	18.5	Wire-cut bricks. †
*26.7	19.1	19.4	18.1	*18.1	16.2	15.9	20.0	17.0	16.8	18.7	Wire-cut bricks. †

[4] Tested in rattler with No. 745.
[5] Tested in rattler with No. 748.
[6] Tested in rattler with No. 747.
[7] Tested in rattler with No. 750.
[8] Tested in rattler with No. 749.

TABLE XII—TESTS OF

Laboratory number.	Bricks sold or manufactured by—	Dimension of brick, (inches.)	Specific gravity.	Absorption in per cent.
1126	West Canton Paving Brick Co., Canton, Ill	3½x3½x8½	2.40	4.0
1131	Murphysboro Paving Brick Co., Murphysboro, Ill	3½x4x8½	2.37	0.85
1132	West Canton Paving Brick Co., Canton, Ill	3½x3½x7½	2.42	1.50
1141	Terre Haute Vitrified Brick Co., Terre Haute, Ind	3½x3½x8½	2.32	4.0
1167	Terre Haute Vitrified Brick Co., Terre Haute, Ind	3½x3½x9	2.35	2.7
1183	Clinton Paving Brick Co., Clinton, Ind	3½x3½x9	2.41	1.3
1194	West Canton Paving Brick Co., Canton, Ill	3½x3½x8½	2.29	3.0
1196	Albion Shale Brick Co., Albion, Ill	3½x4x8½	2.41	1.9
1198	Albion Shale Brick Co., Albion, Ill	..do	2.40	2.2
1199	Albion Shale Brick Co., Albion, Ill	..do	2.40	1.7
1211	Albion Shale Brick Co., Albion, Ill	..do	2.40	1.6
1216	Terre Haute Vitrified Brick Co., Terre Haute, Ind	3½x4x9	2.34	3.4
1217	Terre Haute Vitrified Brick Co., Terre Haute, Ind	..do	2.31	4.2
1218	Terre Haute Vitrified Brick Co., Terre Haute, Ind	..do	2.33	3.1
1219	Terre Haute Vitrified Brick Co., Terre Haute, Ind	..do	2.32	2.7
1246	Albion Shale Brick Co., Albion, Ill	3½x4½x8½	2.41	1.7
1281	.....	3½x3½x8½	2.32	3.1
1293	Danville Brick Co., Danville, Ill	3½x4x8½	2.34	1.8
1294	Danville Brick Co., Danville, Ill	..do	2.36	1.7
1295	Clinton Paving Brick Co., Clinton, Ind	3½x4x9½	2.42	1.3
1328	Alton Brick Co., Alton, Ill	3½x3½x8½	2.35	3.8
1329	Clinton Paving Brick Co., Clinton, Ind	3½x3½x9	2.42	1.9
1330	Clinton Paving Brick Co., Clinton, Ind	..do	2.43	1.6
1331	Clinton Paving Brick Co., Clinton, Ind	..do	2.39	1.5
1341	Clinton Paving Brick Co., Clinton, Ind	..do	2.46	0.8
1342	Clinton Paving Brick Co., Clinton, Ind	..do	2.44	1.4
1343	Murphysboro Paving Brick Co., Murphysboro, Ill	3½x3x8½	2.37	1.2
1345	Alton Brick Co., Alton, Ill	3½x3½x8½	2.33	3.7
1346	Alton Brick Co., Alton, Ill	..do	2.33	3.5
1355	Springfield Paving Brick Co., Springfield, Ill	3½x3½x8½	2.40	1.3
1356	Springfield Paving Brick Co., Springfield, Ill	3½x3½x8½	2.42	1.5
1367	Alton Brick Co., Alton, Ill	3½x3½x8½	.....	.....
1368	Alton Brick Co., Alton, Ill	..do	.....	.....
1369	Alton Brick Co., Alton, Ill	..do	.....	.....
1370	Alton Brick Co., Alton, Ill	..do	.....	.....
1371	Alton Brick Co., Alton, Ill	..do	.....	.....
1372	Alton Brick Co., Alton, Ill	..do	.....	.....
1373	Alton Brick Co., Alton, Ill	..do	.....	.....
1374	Alton Brick Co., Alton, Ill	..do	.....	.....
1385, 1389	Albion Shale Brick Co., Albion, Ill	3½x4x8½	2.39	1.2
1393, 1394	Alton Brick Co., Alton, Ill	3½x3½x8½	.....	.....
1395, 1396	Alton Brick Co., Alton, Ill	..do	.....	.....
1399, 1400	Alton Brick Co., Alton, Ill	..do	.....	.....
1401, 1402	Alton Brick Co., Alton, Ill	..do	.....	.....
1403	Albion Shale Brick Co., Albion, Ill	3½x4x8½	2.39	1.4
1404	Albion Shale Brick Co., Albion, Ill	..do	2.37	1.9
1417	The Barr Clay Co., Streator, Ill	3½x4x8½	2.36	1.4
1418	The Barr Clay Co., Streator, Ill	..do	2.36	1.3
1429	Alton Brick Co., Alton, Ill *	3½x3½x8½	2.31	3.1
1430	Alton Brick Co., Alton, Ill	..do	2.36	2.3
1438	Alton Brick Co., Alton, Ill	..do	2.36	2.6
1447	The Barr Clay Co., Streator, Ill	2½x3½x8½	2.36	1.4
1448	The Barr Clay Co., Streator, Ill	..do	2.38	1.3
1456	Springfield Paving Brick Co., Springfield, Ill	3½x3½x8½	2.42	0.7
1469	Springfield Paving Brick Co., Springfield, Ill	3½x3½x8½	2.40	1.2
1470	Springfield Paving Brick Co., Springfield, Ill	..do	2.42	1.8
1471	Springfield Paving Brick Co., Springfield, Ill	..do	2.35	4.8
1472	Albion Shale Brick Co., Albion, Ill	3½x4½x8½	2.41	1.4

* Bricks broken in rattler.
[1] Tested in rattler with No. 1368.
[2] Tested in rattler with No. 1367.
[3] Tested in rattler with No. 1370.
[4] Tested in rattler with No. 1369.

PAVING BRICKS—1915.

Rattler test—Loss in per cent by weight.											Remarks.
Brick No. 1.	Brick No. 2.	Brick No. 3.	Brick No. 4.	Brick No. 5.	Brick No. 6.	Brick No. 7.	Brick No. 8.	Brick No. 9.	Brick No. 10.	Average loss.	
24.7	*27.1	17.6	32.8	22.2	27.2	31.9	31.5	28.2	31.2	27.4	Repressed Canton block.
32.8	20.6	17.2	20.7	17.7	15.7	24.7	19.8	17.3	20.9	20.7	3 inch wire-cut block.
23.4	*28.5	*39.6	*36.2	19.5	16.5	23.8	*30.2	23.9	22.6	26.4	Repressed Canton block.
17.9	28.9	26.9	17.8	21.2	20.5	20.1	*28.2	19.5	17.7	21.9	Ironstone straight wire-cut block.
*28.2	15.9	25.3	16.1	*23.4	13.5	16.0	20.3	17.5	21.8	19.6	Repressed Ironstone block.
29.4	21.1	18.4	24.2	21.1	18.3	21.2	23.5	22.7	19.4	21.9	Dunn wire-cut block.
*20.2	14.0	*32.2	21 4	*28.5	*29.7	*28.5	19.2	.....	.....	24.2	Straight wire-cut block.
12.0	19.5	18.7	17.0	15.6	20.9	18.3	27.4	22.7	17.3	18.9	Repressed block.
12.8	22.6	14.2	13.6	19.5	19.3	20.8	15.5	19.2	20.8	17.8	Repressed block.
16.5	19.8	15.0	15.7	13.9	16.1	18.1	15.5	19.8	17.3	16.8	Repressed block.
28.6	19.9	21.1	13.7	15.7	22.3	14.5	12.6	18.0	12.9	17.9	Repressed block.
17.7	*23.0	20.9	21.2	41.0	26.5	15.9	*21.3	17.6	24.4	22.9	Repressed Ironstone block.
*28.6	23.2	20.0	*24.3	19.7	19.1	21.2	22.2	13.1	26.9	21.8	Repressed Ironstone block.
13.6	16.7	25.9	24.3	21.1	19.5	17.7	17.5	23.0	15.5	19.5	Repressed Ironstone block.
16.7	17.0	17.8	15.0	15.5	14.2	17.9	18.0	17.0	16.4	16.5	Repressed Ironstone block.
18.0	17 7	17.5	20.3	19.7	19.3	20.7	21.2	15.3	21.0	19.1	Vertical fibre block.
*29.7	16.6	21.1	17.2	20.1	13.9	*25.9	20.4	17.1	21.5	20.3	Straight wire-cut block.
17.7	18.9	*22.2	20.7	19.1	15.2	14.3	16.3	23.0	20.2	18.8	Repressed block.
*21.3	15.6	16.8	17.9	20.1	17.1	19.8	18.0	19.2	16.0	18.2	Repressed block.
21.6	19.0	18.1	*16.0	33.2	14.2	23.5	21.0	23.0	23.3	21.3	Dunn wire-cut block.
22.1	17.9	25.5	20.4	15.3	16.5	27.9	31.9	17.9	18.6	21.4	Dunn wire-cut block.
21.2	21.1	18.9	22.7	19.4	21.1	15.1	25.8	20.6	33.5	21.9	Dunn wire-cut block.
18.6	18.7	18.2	23.0	16.9	19.0	19.0	15.8	26.5	20.8	19.6	Dunn wire-cut block.
20.6	33.4	30.5	23.4	*31.7	26.1	19.1	23.5	22.4	19.5	25.0	Dunn wire-cut block.
16.3	18.6	27.1	*26.4	22.1	23.8	24.1	22.8	23.5	24.7	22.9	Dunn wire-cut block.
18.9	21.8	24.5	24.3	21.8	20.2	33.7	20.9	17.8	34.5	23.8	Dunn wire-cut block.
13.8	20.7	24.6	14.0	26.7	19.9	17.6	17.7	20.1	14.7	19.0	Dunn wire-cut block.
*26.7	17.6	19.8	18.2	30.9	*29.7	14.9	14.2	22.2	15.6	21.0	Dunn wire-cut block.
22.5	17.3	16.9	17.0	22.4	17.4	*41.6	18.3	16.4	15.4	20.5	Dunn wire-cut block.
17.7	16.8	16.2	16.2	17.0	16.7	17.1	26.2	16.8	17.2	17.8	Dunn wire-cut block.
20.3	26.9	18.8	18.8	21.5	18.6	16.7	20.2	18.7	20.3	20.1	Repressed block.
28.4	15.1	16.4	23.8	20.5	(1)	(1)	(1)	(1)	(1)	20.8	Dunn wire-cut block.
18.3	16.9	19.5	24.0	20.4	(2)	(2)	(2)	(2)	(2)	19.8	Dunn wire-cut block.
20.3	16.6	15.9	19.0	15.4	(3)	(3)	(3)	(3)	(3)	17.4	Dunn wire-cut block.
17.7	22.1	26.9	19.4	*26.0	(4)	(4)	(4)	(4)	(4)	22.4	Dunn wire-cut block.
30.2	20.9	19.2	19.5	15.8	(5)	(5)	(5)	(5)	(5)	21.1	Dunn wire-cut block.
22.2	14.1	16.9	17.5	20.5	(6)	(6)	(6)	(6)	(6)	18.2	Dunn wire-cut block.
38.5	27.8	18.6	16.4	14.6	(7)	(7)	(7)	(7)	(7)	23.2	Dunn wire-cut block.
26.2	15.4	27.0	21.9	15.0	(8)	(8)	(8)	(8)	(8)	21.1	Dunn wire-cut block.
23.7	19.3	20.3	18.8	19.1	19.9	17.4	17.7	24.7	17.5	19.8	Repressed block.
23.5	20.7	13.6	20.0	18.3	18.1	21.1	16.4	19.4	18.8	19.0	Dunn wire-cut block.
16.9	15.9	15.5	17.5	20.2	17.7	17.1	23.1	19.8	22.4	18.6	Dunn wire-cut block.
20.2	19.9	17.7	18.6	16.3	*22.6	19.6	18.9	17.8	14.1	18.6	Dunn wire-cut block.
18.4	18.7	26.9	18.0	*23.2	23.9	*31.5	16.0	*23.6	24.7	22.5	Dunn wire-cut block.
22.6	22.1	25.7	18.1	19.7	20.1	19.1	20.3	21.4	20.0	20.9	Vertical fibre block.
25.6	15.2	20.2	22.0	39.3	24.0	21.6	18.6	16.5	29.5	23.2	Vertical fibre block.
15.9	17.2	*27.3	16.6	25.4	17.1	18.7	16.4	18.7	19.9	19.3	Repressed Barr block.
16.1	13.2	16.0	15.3	16.6	17.0	15.9	16.4	16.7	16.0	15.9	Repressed Barr block.
17.3	18.4	18.8	20.8	21.9	15.2	19.0	20.5	17.9	17.5	18.7	Dunn wire-cut block.
19.1	19.2	30.3	33.7	24.1	*22.2	18.9	17.5	18.9	*23.9	22.8	Dunn wire-cut block.
20.3	*18.6	19.1	*20.1	*18.6	*20.5	28.2	*26.5	26.4	21.2	21.9	Dunn wire-cut block.
16.4	15.2	14.5	27.3	12.7	27.8	16.2	13.8	15.2	18.6	17.7	Hillside brick.
14.6	15.2	13.9	20.4	14.8	14.1	16.0	16.0	13.2	13.9	15.2	Hillside brick.
32.1	24.9	25.3	36.4	17.9	20.8	35.4	36.6	30.1	21.4	28.0	Repressed block.
20.1	24.1	25.8	16.3	26.3	23.9	20.0	19.7	18.1	22.7	21.7	Dunn wire-cut block.
21.9	20.1	25.8	20.2	23.1	18.8	*29.2	20.6	22.9	*28.3	23.1	Dunn wi e-cut block.
21.9	22.4	23.4	20.4	20.8	21.8	21.8	22.0	24.4	22.4	22.1	Dunn wire-cut block.
18.6	16.5	16.7	16.8	16.0	17.5	15.8	21.8	17.2	20.8	17.7	Vertical fibre block.

[1] Tested in rattler with No. 1372.
[2] Tested in rattler with No. 1371.
[3] Tested in rattler with No. 1374.
[4] Tested in rattler with No. 1373.

TABLE XII—

Laboratory number.	Bricks sold or manufactured by—	Dimension of brick, (inches.)	Specific gravity.	Absorption in per cent.
1482	The Barr Clay Co., Streator, Ill	3x3¼x8¼	2.38	1.7
1495	C. E. Poston, Attica, Ind	3¼x3¼x8¼	2.47	1.1
1496	C. E. Poston, Attica, Ind	..do	2.47	1.2
1525	The Barr Clay Co., Streator, Ill	3x3¼x8¼	2.35	1.1
1528	C. E. Poston, Attica, Ind	3¼x3¼x8¼	2.44	1.8
1538	The Barr Clay Co., Streator, Ill	3¼x3¼x8¼	2.38	1.5
1539	The Barr Clay Co., Streator, Ill	..do	2.39	1.3
1541	Purington Paving Brick Co., Galesburg, Ill	3¼x3¼x8¼	2.39	1.1
1542	Purington Paving Brick Co., Galesburg, Ill	..do	2.39	1.1
1544	C. E. Poston, Attica, Ind	3¼x3¼x8¼	2.46	2.1
1554	Springfield Paving Brick Co., Springfield, Ill	3¼x3x8¼	2.42	0.9
1581	Murphysboro Paving Brick Co., Murphysboro Ill	3½x4x9	2.41	1.7
1582	Murphysboro Paving Brick Co., Murphysboro, Ill	..do	2.27	1.2
1589	Albion Vitrified Brick Co., Albion, Ill	3½x4x8¼	2.39	2.8
1618	Clinton Paving Brick Co., Clinton, Ind	3½x4x9	2.43	1.3
1631	Purington Paving Brick Co., Galesburg, Ill	3¼x3¼x8¼	2.40	1.1
1635	Murphysboro Paving Brick Co., Murphysboro, Ill	3½x4x9	2.33	1.4
1641		3½x3¼x8¼	2.38	2.0
1656	The Barr Clay Co., Streator, Ill	3½x3¼x8¼	2.38	1.4
1657 1658	Springfield Paving Brick Co., Springfield, Ill	3¼x3¼x8¼	2.38	1.4
1659 1660	Springfield Paving Brick Co., Springfield, Ill	..do	2.40	1.4
1661 1662	Springfield Paving Brick Co., Springfield, Ill	..do	2.44	1.0
1686	C. E. Poston, Attica, Ind	3½x4x8¼	2.45	0.6
1692	Terre Haute Vitrified Brick Co., Terre Haute, Ind	3¼x4x8¼	2.33	1.5
1693	Terre Haute Vitrified Brick Co., Terre Haute, Ind	..do	2.33	1.5
1694	Tette Haute Vitrified Brick Co., Terre Haute, Ind	..do	2.33	1.6
1695	Terre Haute Vitrified Brick Co., Terre Haute, Ind	..do	2.32	2.4
1707	The Barr Clay Co., Streator, Ill	3¼x4x8¼	2.36	1.9
1712	C. E. Poston, Attica, Ind	..do	2.46	1.6
1719	The Barr Clay Co., Streator, Ill	3¼x3¼x8¼	2.37	2.2
1729	The Barr Clay Co., Streator, Ill	3¼x3¼x8¼	2.37	1.4
1745	Springfield Paving Brick Co., Springfield, Ill	3¼x3¼x8¼	2.39	2.5
1746	Springfield Paving Brick Co., Springfield, Ill	..do	2.42	1.1
1748	The Barr Clay Co., Streator, Ill	3¼x3¼x8¼	2.39	1.4
1754	Danville Brick Co., Danville, Ill	3¼x3¼x9	2.34	1.9
1766	Purington Paving Brick Co., Galesburg, Ill	3¼x3¼x8	2.37	1.2
1772	Danville Brick Co., Danville, Ill	3¼x4x8¼	2.34	3.8
1245	Albion Shale Brick Co., Albion, Ill	3¼x4¼x8¼	2.40	2.0

* Bricks broken in rattler.

TABLE XIII—TESTS OF

Laboratory number.	Bricks sold or manufactured by—	Dimension of brick (inches).	Specific gravity.	Absorption in per cent.	Rattler test—loss in per cent by weight.			
					Brick No. 1.	Brick No. 2.	Brick No. 3.	Brick No. 4.
1812	Danville Brick Co., Danville, Ill	3¼x4x8¼	2.34	2.7	18.3	14.1	14.0	21.7
1818	Danville Brick Co., Danville, Ill	..do	2.31	3.6	19.1	15.8	20.3	16.8
1819	Danville Brick Co., Danville, Ill	3¼x4x8¼	2.36	1.6	14.4	17.4	*24.4	16.6
1822	Danville Brick Co., Danville, Ill	3¼x4x8¼		2.7	24.0	19.8	19.3	17.0
1862	Decatur Brick Mfg. Co., Decatur, Ill	3¼x3¼x8¼	2.39	1.2	16.6	*26.1	17.2	23.6
1883	Danville Brick Co., Danville, Ill	3¼x4x8¼	2.27	2.6	17.7	26.1	20.2	20.0
1884	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	3¼x3¼x8¼	2.31	0.8	14.8	16.9	17.4	16.8
1885	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	..do	2.30	3.9	16.6	20.3	17.0	16.8
1886	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	..do	2.31	1.6	*26.0	15.9	15.3	17.5

* Bricks broken in rattler.

Concluded.

Rattler test—Loss in per cent by weight.											Remarks.
Brick No. 1.	Brick No. 2.	Brick No. 3.	Brick No. 4.	Brick No. 5.	Brick No. 6.	Brick No. 7.	Brick No. 8.	Brick No. 9.	Brick No. 10.	Average loss.	
15.7	14.7	17.6	14.7	14.4	16.1	18.4	15.7	13.1	*19.3	16.0	Hillside brick.
20.6	25.4	18.9	21.9	18.9	27.4	20.7	15.5	19.8	17.1	20.6	Repressed Poston paver.
20.8	21.7	27.0	21.5	31.5	23.6	16.6	20.2	21.4	18.1	22.2	Repressed Poston paver.
16.5	16.9	17.5	17.8	17.9	25.3	18.4	20.7	15.6	17.7	18.4	Hillside brick.
18.4	19.2	24.3	30.4	20.9	19.7	23.4	17.3	22.0	38.2	23.4	Repressed Poston paver.
19.8	15.3	18.5	20.8	17.3	23.5	17.7	16.6	18.9	16.3	18.4	Dunn wire-cut block.
18.8	19.9	18.0	18.1	19.4	20.4	*26.9	18.2	18.8	21.2	19.9	Dunn wire-cut block.
20.5	15.0	*19.7	11.1	14.4	28.6	12.2	12.8	12.8	16.9	16.4	Hillside brick.
15.4	24.4	17.0	15.7	12.3	20.8	23.6	16.0	15.7	10.7	17.1	Hillside brick.
23.6	22.7	20.4	27.4	16.9	18.0	20.0	25.7	21.7	17.2	21.3	Poston repressed block.
23.1	20.1	19.6	31.1	18.1	24.5	30.9	27.3	19.2	28.2	24.2	3 inch wire-cut block.
22.2	21.3	20.2	18.7	17.6	18.1	17.6	21.8	28.6	21.4	20.7	Egyptian repressed block.
27.1	19.4	16.3	26.4	21.6	21.1	28.0	20.1	34.3	*27.0	24.1	Egyptian repressed block.
21.1	18.2	16.9	21.2	16.2	21.4	19.2	25.1	15.1	20.2	19.4	Repressed block.
16.7	25.8	22.7	24.3	24.9	29.5	22.7	22.3	23.4	23.7	23.6	Dunn wire-cut block.
19.1	16.1	14.3	19.8	19.0	22.6	14.7	24.1	27.2	21.8	19.9	Repressed block.
29.4	24.0	15.4	18.0	18.4	20.3	19.1	17.3	14.2	14.3	19.0	Egyptian repressed block.
26.5	19.8	17.8	17.3	19.5	18.3	18.6	19.9	16.0	19.8	19.3	Dunn wire-cut block.
20.5	14.0	19.2	20.0	14.6	15.8	18.0	17.1	17.1	21.3	17.8	Dunn wire-cut block.
26.6	25.9	18.2	19.1	25.1	19.4	20.7	17.6	20.5	20.6	21.4	Dunn wire-cut block.
18.5	26.4	22.5	25.0	22.8	19.4	19.2	24.4	19.3	19.0	21.7	Dunn wire-cut block.
20.4	23.2	24.1	23.2	18.6	18.0	24.7	18.8	19.4	19.4	21.0	Dunn wire-cut block.
16.4	18.2	20.3	24.9	17.5	26.9	18.8	16.5	20.4	.....	19.9	Repressed Poston block.
18.4	15.2	14.1	16.7	*22.7	19.0	17.6	15.1	15.4	19.6	17.4	Dunn wire-cut block.
12.2	14.5	17.5	30.8	26.8	*25.4	17.3	*27.3	30.1	15.9	21.8	Dunn wire-cut block.
26.6	12.6	25.0	15.7	17.8	14.7	16.5	14.4	18.3	12.5	17.4	Dunn wire-cut block.
24.3	30.8	16.8	18.6	15.9	*22.6	15.9	15.6	31.9	15.4	20.8	Dunn wire-cut block.
20.6	18.5	20.2	20.4	19.5	23.1	19.6	22.0	16.6	19.8	20.0	Repressed block.
18.4	18.0	17.9	24.0	24.7	23.9	15.9	17.4	*25.2	16.2	20.1	Repressed Poston block.
19.3	19.2	19.4	17.0	21.2	20.4	16.7	17.7	21.1	25.2	19.5	Dunn wire-cut block.
14.4	28.3	16.3	17.7	20.7	17.1	15.8	16.9	15.7	18.3	18.1	Dunn wire-cut block.
17.2	20.5	20.1	16.6	15.7	19.1	*29.4	19.1	18.1	23.6	19.9	Dunn wire-cut block.
24.7	19.8	22.0	23.1	17.6	14.3	21.3	21.3	25.2	14.2	20.4	Dunn wire-cut block.
19.5	*27.9	18.1	21.9	22.7	18.8	20.8	24.2	24.2	24.9	22.3	Dunn wire-cut block.
17.3	19.8	*25.9	18.7	15.2	*25.3	*20.9	18.6	15.8	13.3	19.1	Repressed block.
12.0	15.5	11.6	14.8	14.3	11.3	11.1	14.4	15.6	11.7	13.2	Hillside brick.
16.5	*22.1	20.2	19.7	*21.2	22.0	17.5	*28.8	21.8	*35.9	22.6	Repressed block.
15.7	17.6	20.7	19.8	18.9	15.0	15.8	16.1	17.0	19.1	17.5	Vertical fibre block.

PAVING BRICKS—1916.

Rattler test—loss in per cent by weight.							Remarks.	Place used.
Brick No. 5.	Brick No. 6.	Brick No. 7.	Brick No. 8.	Brick No. 9.	Brick No. 10.	Average.		
15.9	19.5	21.6	16.4	19.1	13.5	17.4	Dunn wire-cut lug brick	Section D, Vermilion County.
17.1	14.1	17.8	18.1	16.3	19.8	17.5	..do	Section D, Vermilion County.
13.5	14.8	*23.8	13.9	15.2	17.5	17.2	..do	Section D, Vermilion County.
17.5	15.0	17.4	15.8	*20.1	14.4	18.0	..do	Section D, Vermilion County.
*17.2	27.9	15.8	*27.9	18.7	14.1	20.5	No. 1 paving bricks, end cut	Producer's sample.
*31.5	17.2	*21.6	20.7	16.9	*21.5	21.3	Dunn wire-cut lug brick	Section D, Vermilion County.
12.4	14.1	16.4	15.1	15.1	18.7	15.8	..do	Section E, Edgar County.
22.1	19.6	18.8	19.1	21.1	21.0	19.2	..do	Section E, Edgar County.
13.5	14.9	15.0	22.0	16.4	16.0	17.2	..do	Section E, Edgar County.

TABLE XIII—

Laboratory number.	Bricks sold or manufactured by—	Dimension of brick (inches).	Specific gravity.	Absorption in per cent.	Rattler test—loss in per cent of weight.			
					Brick No. 1.	Brick No. 2.	Brick No. 3.	Brick No. 4.
1887	Terre Haute Vitrified Brick Co. Terre Haute, Ind.	3½x3¾x8¾	2.30	1.7	14.6	*23.3	17.2	15.7
1888	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	do	2.30	2.4	17.1	17.3	17.8	15.6
1896	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.40	0.8	21.5	17.5	22.2	22.5
1909	Danville Brick Co., Danville, Ill	3½x4x8¾	2.32	2.2	*32.0	16.9	17.7	16.4
1928	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.38	3.1	20.1	28.4	18.4	25.6
1931	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.43	4.3	.....	.....	.....	.....
1932	Springfield Paving Brick Co., Springfield, Ill	do	2.43	4.3	.....	.....	.....	.....
1933	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.43	4.3	.....	.....	.....	.....
1934	Springfield Paving Brick Co., Springfield, Ill	do	2.43	4.3	.....	.....	.....	.....
1937	Springfield Paving Brick Co., Springfield, Ill	do	2.33	0.4	17.7	20.2	21.8	16.7
1938	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.42	0.5	18.7	19.4	18.2	16.3
1940	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	3½x3¾x8¾	2.35	1.0	16.8	23.1	16.3	19.0
1941	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	do	2.31	2.6	27.4	17.9	19.6	17.8
1942	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	do	2.38	2.3	15.8	21.0	20.5	13.3
1947	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.35	3.2	26.9	40.2	28.2	18.0
1951	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.42	0.8	33.2	23.3	22.2	20.7
1953	Springfield Paving Brick Co., Springfield, Ill	do	2.43	1.1	28.2	16.8	21.8	19.2
1954	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.36	6.6	22.5	18.9	24.7	17.7
1955	Springfield Paving Brick Co., Springfield, Ill	do	2.36	5.8	*35.5	*48.5	17.4	29.0
1956	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.40	0.9	19.2	21.6	16.2	23.4
1957	Springfield Paving Brick Co., Springfield, Ill	do	2.42	1.2	22.5	21.9	20.5	19.6
1960	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.42	0.7	26.0	*35.0	20.7	23.6
1961	Springfield Paving Brick Co., Springfield, Ill	do	2.42	0.5	17.7	20.3	24.5	17.0
1962	Springfield Paving Brick Co., Springfield, Ill	do	2.41	1.4	29.0	19.5	21.9	21.8
1963	Springfield Paving Brick Co., Springfield, Ill	do	2.39	0.7	18.9	21.1	17.8	20.6
1954	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.44	0.5	29.1	22.4	18.7	27.2
1969	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.41	1.1	22.9	18.5	21.3	25.5
1973	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.35	1.5	16.5	25.6	22.5	24.6
1974	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.34	2.0	21.7	19.3	20.6	20.7
1975	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.42	1.2	31.2	19.3	22.2	22.4
1978	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.38	1.3	20.9	24.2	25.9	18.5
1979	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.40	1.8	29.6	19.4	17.1	25.9
1980	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.41	0.9	20.9	16.7	20.4	22.4
1981	Danville Brick Co., Danville, Ill	3¾x3¾x8¾	2.34	1.9	19.3	15.5	17.0	19.9
1984	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.42	0.6	18.3	23.8	18.4	21.1
1985	Springfield Paving Brick Co., Springfield, Ill	3½x4x8¾	2.38	3.6	26.1	26.0	30.0	22.0
1983	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.43	0.4	14.9	18.7	17.7	22.6
1987	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.42	0.5	18.2	30.8	49.9	31.5
2001	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.40	0.5	15.7	25.5	21.6	19.8
2002	Springfield Paving Brick Co., Springfield, Ill	do	2.40	1.2	22.1	22.3	35.1	19.7
2003	Springfield Paving Brick Co., Springfield, Ill	do	2.42	0.7	23.7	18.2	20.6	20.3
2004	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.39	3.2	*44.7	25.1	17.3	31.3
2012	Clinton Paving Brick Co., Clinton, Ind	3½x3¾x8¾	2.40	2.0	28.5	35.2	23.1	28.4
2013	Springfield Paving Brick Co., Springfield, Ill	3¾x3¾x8¾	2.21	0.9	20.2	26.2	20.3	19.3
2014	Springfield Paving Brick Co., Springfield, Ill	do	.....	.....	26.3	26.9	23.9	30.1
2024	Springfield Paving Brick Co., Springfield, Ill	do	2.39	1.7	17.6	17.4	26.7	16.3
2029	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.20	1.3	25.0	19.8	26.7	18.8
2030	Springfield Paving Brick Co., Springfield, Ill	do	2.39	2.6	24.3	30.8	20.5	23.2
2031	Springfield Paving Brick Co., Springfield, Ill	do	2.43	1.1	18.0	22.7	30.0	19.5
2047	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.40	2.0	35.7	20.2	26.2	16.8
2048	Springfield Paving Brick Co., Springfield, Ill	do	2.39	1.8	31.4	23.4	17.6	21.0
2049	Springfield Paving Brick Co., Springfield, Ill	do	2.20	1.3	21.6	16.3	28.7	21.6
2059	Purington Paving Brick Co., Galesburg, Ill	3½x3¾x8½	2.44	0.5	19.4	20.6	18.7	16.3
2060	Purington Paving Brick Co., Galesburg, Ill	do	2.44	0.4	18.5	27.2	18.5	24.2
2071	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¾	2.37	1.6	34.2	18.1	24.0	24.5
2072	Springfield Paving Brick Co., Springfield, Ill	do	2.40	1.6	27.1	16.7	21.5	26.1
2073	Clinton Paving Brick Co., Clinton, Ind	3¾x3¾x9½	2.40	1.5	28.0	30.8	31.2	31.9
2074	Clinton Paving Brick Co., Clinton, Ind	do	2.43	2.0	35.0	34.7	32.3	57.3
2075	Clinton Paving Brick Co., Clinton, Ind	do	2.41	1.8	46.1	30.6	33.0	28.3
2096	Danville Brick Co., Danville, Ill	3½x3¾x8¾	2.34	1.9	18.2	17.6	24.9	16.4
2097	Danville Brick Co., Danville, Ill	do	2.35	1.6	17.8	21.1	17.8	14.2

* Bricks broken in rattler.

Continued.

Rattler test—loss in per cent by weight.							Remarks.	Place used.
Brick No. 5.	Brick No. 6.	Brick No. 7.	Brick No. 8.	Brick No. 9.	Brick No. 10.	Average.		
20.3	14.0	17.1	13.9	14.5	16.5	16.7	Dunn wire-cut lug brick	Section E, Edgar County.
27.3	17.8	20.4	20.5	16.4	21.2	19.1	..do	Section E, Edgar County.
14.2	19.4	20.2	20.5	18.8	19.4	19.6	..do	Section B, Platt County.
19.1	22.4	17.9	24.6	18.2	15.3	20.0	..do	Section D, Route 2, Vermilion County.
27.6	21.9	26.5	20.6	26.8	19.0	23.5	..do	Section G, Sangamon County.
.....	.....	.....	.....	.....	.....	22.6	..do	Section G, Sangamon County.
.....	.....	.....	.....	.....	.....	25.8	..do	Section G, Sangamon County.
.....	.....	.....	.....	.....	.....	26.5	..do	Section G, Sangamon County.
.....	.....	.....	.....	.....	.....	22.5	..do	Section G, Sangamon County.
21.7	25.8	16.8	25.1	20.5	20.4	20.7	..do	Proposed for Section G, Sangamon County.
18.2	18.7	21.9	20.9	18.7	18.7	19.0	..do	Proposed for Section G, Sangamon County.
32.2	15.5	13.5	23.8	19.2	14.5	19.4	..do	Section B, Route 8, Coles County.
23.5	26.4	15.3	15.1	17.9	18.6	20.0	..do	Section B, Route 8, Coles County.
17.3	19.7	16.8	18.3	15.0	*34.6	19.3	..do	Section B, Route 8, Coles County.
22.4	24.1	22.4	34.5	25.3	21.9	26.4	..do	Section B, Platt County.
21.8	19.8	31.4	18.3	18.3	19.7	22.9	..do	Section B, Platt County.
18.0	19.0	*35.2	20.5	26.6	36.3	24.1	..do	Section G, Sangamon County.
20.3	21.9	28.3	24.8	15.1	49.7	24.4	..do	Section G, Sangamon County.
23.9	24.4	22.6	25.9	27.4	22.4	27.7	..do	Section G, Sangamon County.
23.4	23.1	17.4	22.3	24.8	16.9	21.8	..do	Proposed for Section G, Sangamon County.
20.8	18.8	21.9	23.5	24.5	23.9	21.8	..do	Proposed for Section G, Sangamon County.
19.1	25.0	32.9	21.7	19.2	19.3	24.3	..do	Section B, Platt County.
19.9	26.9	22.9	20.0	15.2	22.5	20.7	..do	Section B, Platt County.
25.1	21.8	17.5	23.2	22.7	21.2	22.4	..do	Section B, Platt County.
18.7	27.3	19.6	27.3	22.4	24.7	22.3	..do	Section B, Platt County.
20.7	25.4	24.5	40.7	18.3	21.2	24.8	..do	Section B, Platt County.
17.4	24.8	24.8	26.6	18.0	21.5	22.1	..do	Section G, Sangamon County.
22.7	18.7	20.3	30.3	18.8	16.5	21.6	..do	Section G, Sangamon County.
20.3	18.6	21.5	21.7	18.2	17.4	20.0	..do	Section G, Sangamon County.
21.1	18.1	17.4	17.1	19.0	21.5	20.9	..do	Proposed for Section G, Sangamon County.
20.1	22.2	29.3	19.1	18.9	21.1	22.0	..do	Section B, Route 6, Platt County.
18.1	24.4	25.6	25.1	24.5	28.0	23.8	..do	Section B, Route 6, Platt County.
21.8	25.4	18.2	21.3	26.3	28.4	22.2	..do	Section B, Route 6, Platt County.
16.5	*25.3	14.6	14.5	15.4	16.1	17.4	..do	Section B, Route 6, Platt County.
23.6	19.6	17.0	21.5	20.7	14.0	19.8	..do	Section G, Sangamon County.
22.0	22.7	24.6	27.7	27.6	20.5	24.9	..do	Section G, Sangamon County.
19.5	33.3	23.1	26.0	23.6	29.6	22.9	..do	Section G, Sangamon County.
21.8	25.1	22.8	23.9	30.6	17.8	27.2	..do	Section B, Route 6, Platt County.
24.1	20.9	40.0	19.9	18.7	50.2	25.6	..do	Section B, Route 6, Platt County.
19.9	17.4	21.5	24.8	29.9	30.6	24.3	..do	Section B, Route 6, Platt County.
22.3	19.1	17.7	16.6	21.0	23.2	20.3	..do	Section B, Route 6, Platt County.
*37.3	40.6	36.9	25.3	*100	20.8	31.0	..do	Section B, Route 6, Platt County.
25.4	23.5	26.7	24.7	24.2	20.5	26.0	..do	Producer's sample.
19.7	20.5	21.8	25.9	19.3	22.0	21.5	..do	Section B, Route 6, Platt County.
23.6	18.5	34.1	21.0	22.7	29.1	25.6	..do	Section B, Route 6, Platt County.
21.8	26.7	29.0	23.5	33.6	20.1	23.3	..do	Section B, Route 6, Platt County.
27.2	20.2	24.5	22.2	32.5	26.4	24.3	..do	Section B, Route 6, Platt County.
32.3	29.6	22.5	36.2	26.6	20.8	26.4	..do	Section B, Route 6, Platt County.
18.6	21.1	17.5	22.7	34.9	25.1	23.0	..do	Section B, Route 6, Platt County.
27.5	23.0	22.1	25.1	19.6	37.6	26.4	..do	Section B, Route 6, Platt County.
20.8	24.6	31.8	33.2	33.7	32.3	27.0	..do	Section B, Route 6, Platt County.
18.4	22.4	21.4	24.6	17.9	20.0	21.1	..do	Section B, Route 6, Platt County.
21.7	26.7	17.7	22.2	*25.1	23.1	21.2	Repressed block	Section C, Warren County.
22.2	21.7	18.5	19.9	17.1	24.5	26.7	..do	Sterling Towhsnip, Whiteside County.
21.9	15.5	*36.3	21.8	32.5	19.5	24.8	Dunn wire-cut lug brick	Section B, Route 6, Platt County.
23.3	23.7	23.2	26.6	23.0	22.3	24.3	..do	Section B, Route 6, Platt County.
27.8	31.3	26.6	36.0	25.9	30.4	30.0	..do	Mattoon Township Coles County.
23.7	26.4	35.8	26.7	28.4	29.7	33.0	..do	Mattoon Township, Coles County.
25.7	30.5	31.7	27.7	27.9	38.4	32.0	..do	Mattoon Township, Coles County.
17.4	21.8	14.2	17.1	16.2	20.5	18.4	..do	Mattoon Township, Coles County.
17.2	15.4	20.0	26.7	26.5	19.9	19.7	..do	Mattoon Township, Coles County.

TABLE XIII—

Laboratory number.	Bricks sold or manufactured by—	Dimension of brick (inches).	Specific gravity.	Absorption in per cent.	Rattler test—loss in per cent by weight.			
					Brick No. 1.	Brick No. 2.	Brick No. 3.	Brick No. 4.
2098	Danville Brick Co., Danville, Ill	3½x3¾x8¼	2.37	1.9	17.1	17.2	18.4	19.5
2106	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¼	....	....	20.0	49.5	22.7	17.7
2107	Springfield Paving Brick Co., Springfield, Ill	..do	....	....	63.6	30.4	20.6	24.3
2112	Clinton Paving Brick Co., Clinton, Ind	3½x3¾x9½	2.41	1.4	31.8	26.8	27.0	28.7
2113	Clinton Paving Brick Co., Clinton, Ind	3½x3¾x8¼	2.40	3.1	28.7	26.5	22.6	31.8
2124	Purington Paving Brick Co., Galesburg, Ill	3¾x3¼x8¼	2.46	1.1	17.9	20.9	18.9	18.2
2131	Clinton Paving Brick Co., Clinton, Ind	3½x3¾x8¼	2.42	0.1	25.2	30.1	25.3	23.3
2144	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¼	2.43	2.2	23.2	26.2	30.8	25.7
2145	Springfield Paving Brick Co., Springfield, Ill	..do	2.42	1.7	33.5	20.2	28.6	25.4
2172	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¼	2.42	1.3	19.8	28.4	24.7	20.2
2173	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8¼	2.40	1.2	19.6	15.9	19.4	20.8
2174	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8½	2.42	1.5	17.2	20.6	34.2	19.0
2175	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8½	2.40	0.1	21.7	17.9	18.3	19.8
2176	Purington Paving Brick Co., Galesburg, Ill	3¾x4x8½	2.39	2.2	*20.6	17.3	18.8	21.9
2183	Springfield Paving Brick Co., Springfield, Ill	3½x3¾x8½	2.38	2.3	19.2	20.8	23.9	21.1
2184	Springfield Paving Brick Co., Springfield, Ill	3½x4x8¼	2.38	1.9	30.1	*28.2	30.5	19.1
2185	Springfield Paving Brick Co., Springfield, Ill	..do	2.41	2.4	19.6	18.8	19.1	21.0
2186	Springfield Paving Brick Co., Springfield, Ill	..do	2.36	5.0	14.4	18.5	42.1	20.4
2187	Purington Paving Brick Co., Galesburg, Ill	3½x4x8½	2.39	0.1	18.1	19.7	20.0	21.5
2195	Springfield Paving Brick Co., Springfield, Ill	3½x4x8¼	2.39	1.8	20.0	21.4	17.8	41.4
2196	Springfield Paving Brick Co., Springfield, Ill	3½x4x8½	2.42	1.1	30.1	25.2	17.3	15.9
2197	Danville Brick Co., Danville, Ill	..do	2.25	1.4	17.7	18.2	26.2	25.6
2198	Danville Brick Co., Danville, Ill	..do	2.34	4.5	21.6	18.4	22.9	23.2
2208	Danville Brick Co., Danville, Ill	3½x4x8¼	2.32	4.0	17.2	21.7	20.4	19.4
2209	Danville Brick Co., Danville, Ill	..do	2.35	2.8	20.6	16.7	15.9	16.4
2212	Albion Shale Brick Co., Albion, Ill	3½x4x8½	2.36	4.1	15.6	15.9	21.3	17.1
2213	Albion Shale Brick Co., Albion, Ill	3½x4x8¼	2.39	2.6	20.3	18.5	22.2	16.8
2214	Albion Shale Brick Co , Albion, Ill	..do	2.37	2.8	14.9	17.5	27.0	35.7
2215	Albion Shale Brick Co., Albion, Ill	3½x4x8½	2.37	3.6	14.8	14.8	18.4	19 4
2216	Albion Shale Brick Co., Albion, Ill	3½x4x8¼	2.41	3.0	21.6	17.3	17.9	18.5
2218	Springfield Paving Brick Co., Springfield, Ill	..do	2.44	0.9	22.6	*31.1	20.2	17.5
2225	Springfield Paving Brick Co., Springfield, Ill	..do	2.41	1.5	18.7	17.1	19.9	20.6
2232	Springfield Paving Brick Co., Springfield, Ill	..do	2.40	2.2	17.3	21.4	16.7	21.6
2233	Springfield Paving Brick Co., Springfield, Ill	..do	2.43	1.5	*38.5	28.6	18.0	18.2
2234	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	1.1	18.1	17.2	18.0	*33.9
2235	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	1.4	19.8	17.5	17.0	20.0
3001	Springfield Paving Brick Co., Springfield, Ill	..do	2.43	1.4	17.1	18.3	20.2	15.3
3002	Springfield Paving Brick Co., Springfield, Ill	..do	2.42	1.7	16.9	17.7	19.0	20.9
3011	Albion Vitrified Brick Co., Albion, Ill	..do	2.38	1.3	21.1	18.8	18.0	17.8
3012	Albion Vitrified Brick Co., Albion, Ill	..do	2.41	1.7	19.8	22.4	17.1	18.7
3013	Albion Vitrified Brick Co., Albion, Ill	..do	2.41	1.6	17.8	*25.1	18.0	22.6
3017	Springfield Paving Brick Co., Springfield, Ill	3¾x4x8¼	2.41	1.6	21.7	17.4	17.5	19.6
3018	Springfield Paving Brick Co., Springfield, Ill	3¾x4x8¼	2.40	2.0	15.3	*30.5	21.6	17.6
3019	Springfield Paving Brick Co., Springfield, Ill	..do	2.40	2.1	17.1	15.3	19.9	20.8

* Bricks broken in rattler.

Continued.

Rattler test—loss in per cent by weight.							Remarks.	Place used.
Brick No. 5.	Brick No. 6.	Brick No. 7.	Brick No. 8.	Brick No. 9.	Brick No. 10.	Average.		
20.8	17.1	22.4	20.0	19.7	16.4	18.9	Dunn wire-cut lug brick	Mattoon Township, Coles County.
*23.7	39.4	34.0	20.5	18.4	*27.3	27.3	..do	Section B, Route 6, Platt County.
66.0	27.0	23.4	27.2	20.7	38.6	34.2	..do	Section B, Route 6, Platt County.
26.6	24.3	30.3	33.4	31.2	*41.0	30.4	..do	Mattoon Township, Coles County.
27.3	27.6	28.7	22.3	40.3	31.4	28.7	..do	Mattoon Township, Coles County.
21.8	23.0	17.5	24.5	19.5	16.8	19.9	Repressed block	Sterling Township, Whiteside County.
20.1	20.5	17.4	22.4	23.8	37.3	24.5	Dunn wire-cut lug brick	Producer's sample.
21.2	14.3	20.1	22.7	31.0	26.7	24.2	..do	Section B, Route 6, Plat County.
29.1	32.3	37.7	23.2	21.7	27.1	27.9	..do	Section B, Route 6, Platt County.
19.3	25.8	19.1	18.0	16.8	22.0	21.4	..do	Section I, Route 8, Sangamon County.
30.7	20.9	20.3	17.2	19.6	19.8	20.4	..do	Section I, Route 8, Sangamon County.
26.3	18.0	18.1	19.7	19.7	17.4	21.0	..do	Section I, Route 8, Sangamon County.
17.3	18.0	19.9	18.8	18.6	*32.5	20.3	..do	Section I, Route 8, Sangamon County.
24.8	17.5	18.9	24.4	17.6	21.5	20.3	Repressed block	Section C, Warren County.
33.1	18.9	21.6	31.3	30.8	20.9	24.2	Dunn wire-cut lug brick	Section B, Route 6, Platt County.
19.9	30.0	17.7	21.3	22.6	31.3	25.1	..do	Section B, Route 6, Platt County.
40.6	21.9	21.4	17.6	31.0	14.8	22.6	..do	Section B, Route 6, Platt County.
23.2	16.8	14.4	20.9	20.3	*29.7	22.1	..do	Section B, Route 6, Platt County.
23.0	17.5	21.6	15.6	19.3	14.1	19.0	Repressed block	Sterling Township, Coles County.
18.9	19.6	18.6	22.5	25.3	20.4	22.6	Dunn wire-cut lug brick	Section B, Route 6, Platt County.
18.1	23.8	27.5	26.7	35.9	23.9	24.4	..do	Section B, Route 6, Platt County.
16.5	15.5	20.4	15.4	13.9	14.4	18.4	..do	Section D, Route 1, Douglas County.
18.4	31.6	*35.4	19.7	21.7	20.7	23.4	..do	Section D, Route 1, Douglas County.
15.1	14.5	15.9	20.9	43.5	24.2	21.3	..do	Section D, Route 1, Douglas County.
15.5	19.6	13.9	16.3	17.3	21.9	17.4	..do	Section D, Route 1, Douglas County.
23.4	25.4	23.9	24.1	19.5	16.2	20.2	Repressed block	Section B, Route 2, Lawrence County.
19.2	21.6	21.6	16.8	19.3	18.4	19.5	..do	Section B, Route 2, Lawrence County.
17.2	*23.0	27.9	25.2	25.0	14.5	22.8	..do	Section B, Route 2, Lawrence County.
22.2	18.7	23.5	16.9	27.8	18.3	19.5	..do	Section B, Route 2, Lawrence County.
13.3	19.2	20.3	16.5	14.4	14.5	17.4	..do	Section B, Route 2, Lawrence County.
19.5	15.7	18.8	26.4	17.9	16.1	20.6	Dunn wire-cut lug brick	Section I, Route 8, Sangamon County.
18.3	29.7	34.2	16.9	26.8	21.2	22.3	..do	Section B, Route 6, Platt County.
21.2	18.9	19.4	23.3	20.8	16.9	19.8	..do	Section I, Route 8, Sangamon County.
15.8	18.2	16.6	17.4	12.9	14.2	19.8	..do	Section I, Route 8, Sangamon County.
*33.4	33.8	27.6	17.2	19.0	25.3	24.3	..do	Section B, Route 6, Platt County.
19.5	25.6	24.4	16.5	17.9	17.3	19.6	..do	Section I, Route 8, Sangamon County.
14.2	17.6	19.6	14.8	27.2	20.0	18.4	..do	Section I, Route 8, Sangamon County.
19.4	17.6	16.2	21.4	14.0	19.2	18.2	..do	Section I, Route 8, Sangamon County.
19.2	18.8	17.3	20.0	15.8	15.5	18.2	..do	Mattoon Township, Coles County.
23.8	17.7	17.8	15.6	19.1	19.5	19.2	..do	Mattoon Township, Coles County.
17.9	21.0	18.9	16.3	20.8	19.8	19.8	..do	Mattoon Township, Coles County.
17.1	14.8	20.8	16.3	17.0	19.1	18.1	..do	Section I, Route 8, Sangamon County.
19.4	17.3	21.8	17.6	17.2	18.2	19.7	..do	Section I, Route 8, Sangamon County.
17.9	21.0	19.7	17.5	15.2	20.4	18.5	..do	Section I, Route 8, Sangamon County.

TABLE XIII—

Laboratory number.	Bricks sold or manufactured by—	Dimension of brick (inches).	Specific gravity.	Absorption in per cent.	Rattler test—loss in per cent of weight.			
					Brick No. 1.	Brick No. 2.	Brick No. 3.	Brick No. 4.
3033	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8¼	2.44	1.3	19.4	18.2	18.6	21.0
3034	Springfield Paving Brick Co., Springfield, Ill.	..do	2.41	2.2	23.2	21.9	27.9	17.6
3035	Springfield Paving Brick Co., Springfield, Ill.	..do	2.42	1.1	18.6	20.5	22.9	21.7
3036	Danville Brick Co., Danville, Ill.	..do	2.34	1.6	18.6	24.4	15.6	19.6
3037	Danville Brick Co., Danville, Ill.	..do	2.35	4.9	29.8	20.9	21.9	21.1
3038	Danville Brick Co., Danville, Ill.	..do	2.35	1.7	17.5	16.6	28.3	28.9
3056	Springfield Paving Brick Co., Springfield, Ill.	..do	2.44	1.6	29.2	*24.6	18.8	18.3
3057	Springfield Paving Brick Co., Springfield, Ill.	..do	2.43	1.3	20.1	*18.3	15.1	18.7
3059	Purington Paving Brick Co., Galesburg, Ill.	3½x4x8¼	2.43	0.6	21.5	16.8	15.3	16.3
3060	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8¼	2.42	1.4	17.9	28.8	20.4	24.1
3067	Springfield Paving Brick Co., Springfield, Ill.	..do	2.37	2.3	24.6	17.3	26.5	22.9
3068	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	..do	2.36	2.3	18.0	15.8	*24.7	19.9
3069	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	..do	2.32	2.3	17.3	15.7	15.4	21.3
3070	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	3½x4x8¼	2.34	1.3	*25.9	19.4	25.4	15.5
3077	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8¼	2.42	1.1	23.2	20.6	16.3	18.0
3078	Springfield Paving Brick Co., Springfield, Ill.	..do	2.40	1.5	21.7	19.5	31.1	17.0
3079	Springfield Paving Brick Co., Springfield, Ill.	..do	2.41	2.7	*21.4	21.8	15.4	*29.5
3081	Poston Brick Co., Springfield, Ill.	3½x4x8¼	.....	.....	27.5	29.8	29.0	30.8
3082	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8¼	2.45	1.7	19.0	17.7	18.0	19.1
3083	Springfield Paving Brick Co., Springfield, Ill.	..do	2.40	1.7	19.9	18.6	17.4	22.4
3084	Springfield Paving Brick Co., Springfield, Ill.	..do	2.42	1.1	18.7	19.5	17.0	19.0
3090	Albion Shale Brick Co., Albion, Ill.	.....	2.39	2.4	16.0	21.8	31.4	18.0
3091	Albion Shale Brick Co., Albion, Ill.	.....	2.41	1.5	28.4	19.6	15.5	23.2
3092	Albion Shale Brick Co., Albion, Ill.	.....	2.41	0.9	26.2	15.8	16.0	25.8
3106	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8¼	2.41	2.7	23.2	23.1	15.9	*32.3
3107	Purington Paving Brick Co., Galesburg, Ill.	3½x4x9½	2.40	0.9	16.2	16.5	31.5	18.7
3172	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8¼	2.40	2.9	15.7	24.7	21.9	17.4
3174	Barr Clay Co., Streator, Ill.	3½x4x8¼	2.40	1.8	*22.6	17.9	17.9	19.7
3180	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8¼	2.32	2.1	24.7	22.8	22.6	21.4
3188	Barr Clay Co., Streator, Ill.	3½x3x8½	2.35	2.0	18.7	19.6	15.3	19.4
3195	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8½	2.43	1.8	21.2	19.9	32.7	22.7
3196	Springfield Paving Brick Co., Springfield, Ill.	..do	2.42	2.0	20.2	24.6	*30.6	20.6
3197	Springfield Paving Brick Co., Springfield, Ill.	..do	2.43	1.2	18.3	24.8	23.0	21.8
3209	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8¼	2.42	1.9	16.2	*23.2	*31.6	*29.7
3210	Springfield Paving Brick Co., Springfield, Ill.	3½x4x8½	2.43	0.9	21.7	20.4	18.5	21.8
3211	Springfield Paving Brick Co., Springfield, Ill.	..do	2.41	2.9	24.2	31.2	19.1	31.6
3224	Springfield Paving Brick Co., Springfield, Ill.	..do	2.42	1.4	18.9	23.5	33.9	22.7
3229	Alton Brick Co., Alton, Ill.	3½x3¾x8¼	2.36	2.8	20.8	20.1	18.8	21.0
3230	Alton Brick Co., Alton, Ill.	..do	2.38	3.5	17.9	20.5	20.6	23.2
3231	Barr Clay Co., Streator, Ill.	3½x4x8½	2.39	1.7	21.8	17.7	20.6	23.6

* Bricks broken in rattler.

Continued.

Rattler test—loss in per cent by weight.							Remarks.	Place used.
Brick No. 5.	Brick No. 6.	Brick No. 7.	Brick No. 8.	Brick No. 9.	Brick No. 10.	Average.		
22.2	16.9	24.3	18.7	18.3	17.5	19.5	Dunn wire-cut lug brick	Section I, Route 8, Sangamon County.
32.2	16.3	17.4	21.7	18.6	17.8	21.5	..do	Section I, Route 8, Sangamon County.
14.2	18.5	17.4	17.0	22.7	18.3	19.2	..do	Section B, Route 6, Piatt County.
16.7	16.1	19.2	25.3	19.7	*22.1	19.7	..do	Section D, Route 1, Douglas County.
*32.2	17.1	19.6	18.7	*22.9	29.2	23.3	..do	Section D, Route 1, Douglas County.
15.1	17.3	16.2	15.4	18.3	.....	19.3	..do	Section D, Route 1, Douglas County.
18.9	24.2	16.4	14.9	28.4	17.8	21.2	..do	Section I, Route 8, Sangamon County.
19.0	16.8	23.1	22.6	21.1	21.9	19.8	..do	Section I, Route 8, Sangamon County.
18.7	16.9	19.3	.....	.....	.....	17.8	Repressed brick	Bond issue roads, Sterling Township, Whiteside County.
18.9	20.5	13.6	18.1	26.8	18.5	20.8	Dunn wire-cut lug brick	Section I, Route 8, Sangamon County.
19.1	19.9	19.2	20.4	23.1	21.2	21.4	..do	Section I, Route 8, Sangamon County.
16.6	13.8	20.4	18.0	20.3	16.2	18.4	..do	Coles County.
24.8	14.4	20.3	15.7	19.0	18.9	18.3	..do	Coles County.
*20.2	*19.8	13.8	*24.1	27.0	14.6	20.6	..do	Coles County.
15.5	16.6	20.1	19.6	18.5	16.9	18.5	..do	Section I, Route 8, Sangamon County.
17.2	19.1	15.4	18.8	21.2	22.1	20.3	..do	Section I, Route 8, Sangamon County.
23.9	20.9	19.3	23.1	24.1	27.6	22.7	..do	Section I, Route 8, Sangamon County.
27.9	26.6	20.1	20.7	30.9	25.9	26.9	Straight wire-cut brick	Manufacturer's sample.
19.7	19.5	18.8	18.6	20.9	17.8	18.9	Dunn wire-cut lug brick	Section I, Route 8, Sangamon County.
*24.8	19.7	16.2	16.2	16.9	*26.6	19.9	..do	Section I, Route 8, Sangamon County.
18.2	20.6	16.1	18.9	18.0	14.9	18.1	..do	Section I, Route 8, Sangamon County.
13.6	16.0	23.2	21.1	17.7	15.5	19.4	Repressed brick	Coles County.
15.8	19.8	20.0	23.0	23.5	22.8	21.2	..do	Coles County.
20.9	26.4	18.9	16.5	21.0	17.4	20.5	..do	Coles County.
*27.7	18.1	23.1	19.7	*28.1	20.0	23.1	Dunn wire-cut lug brick	Section I, Route 8, Sangamon County.
16.4	21.5	18.0	17.9	19.3	19.6	19.6	Repressed brick	Bond issue roads, Sterling Township, Whiteside County.
20.6	21.8	22.7	24.9	22.6	21.1	21.3	Dunn wire-cut lug brick	Section I, Route 8, Sangamon County.
15.7	20.0	17.4	21.1	26.8	18.8	19.8	..do	Section A, Route 9, LaSalle County.
20.5	26.4	16.8	18.9	20.6	23.8	21.9	..do	Section I, Route 8, Sangamon County.
20.4	21.4	17.4	29.2	18.4	20.4	20.0	Hillside brick	Section C, Peoria County
19.2	17.4	21.3	23.1	20.6	22.6	22.0	Dunn wire-cut lug brick	Section I, Route 8, Sangamon County
20.4	18.7	33.7	19.6	26.9	19.4	23.5	..do	Section I, Route 8, Sangamon County.
15.3	*20.3	18.1	25.2	21.0	21.4	20.9	..do	Section I, Route 8, Sangamon County.
18.0	17.1	17.7	23.1	17.2	18.8	21.3	..do	Section I, Route 8, Sangamon County.
20.6	16.8	19.1	17.7	22.7	19.9	19.9	..do	Section I, Route 8, Sangamon County.
16.4	21.1	21.1	19.5	20.2	*27.3	23.1	..do	Section I, Route 8, Sangamon County.
16.9	16.5	24.8	16.5	19.0	18.1	21.0	..do	Section I, Route 8, Sangamon County.
*19.4	15.4	21.0	20.0	18.6	17.8	19.3	..do	Section C, Route 3, Bond County.
21.0	24.9	*24.8	24.0	17.5	*22.4	21.7	..do	Section C, Route 3, Bond County.
17.2	22.8	20.8	22.5	18.2	23.0	20.8	..do	Section F, Kankakee County.

TABLE XIII—

Laboratory number.	Bricks sold or manufactured by—	Dimension of brick (inches).	Specific gravity.	Absorption in per cent.	Rattler test—loss in per cent by weight.			
					Brick No. 1.	Brick No. 2.	Brick No. 3.	Brick No. 4.
3232	Barr Clay Co., Streator, Ill	3½x4x8½	2.36	2.6	36.7	20.7	16.5	21.2
3233	Barr Clay Co., Streator, Ill	..do	2.39	1.0	18.7	21.4	19.8	24.4
3234	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	3¾x4x9	2.37	7.8	45.0	21.6	31.1	29.6
3236	Springfield Paving Brick Co., Springfield, Ill	3½x4x8½	....	....	23.5	22.6	22.6	22.2
3240	Purington Paving Brick Co., Galesburg, Ill	3½x4x8½	2.43	0.9	19.0	17.5	25.7	23.8
3241	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	3½x3¾x8¾	2.32	2.3	14.1	14.6	†30.3	17.1
3242	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	3½x4x8¾	2.27	1.9	*20.7	12.7	*18.3	15.6
3243	Terre Haute Vitrified Brick Co., Terre Haute, Ind.	..do	2.31	0.8	*19.5	*20.9	15.0	14.1
3252	Danville Brick Co., Danville, Ill	3½x3¾x8¾	2.35	1.7	14.9	17.9	16.2	17.2
3253	Danville Brick Co., Danville, Ill	3½x4x8¾	2.36	2.6	16.3	14.5	15.4	17.9
3254	Barr Clay Co., Streator, Ill	3½x4x9	2.33	4.4	27.6	24.2	20.7	20.6
3255	Barr Clay Co., Streator, Ill	..do	2.32	4.5	20.4	25.1	20.4	33.4
3310	Barr Clay Co., Streator, Ill	2¾x3¾x8½	2.39	0.7	21.7	19.4	18.7	20.9
3340	Danville Brick Co., Danville, Ill	3½x4x8¾	2.37	3.3	14.9	15.8	18.5	16.8
3356	Purington Paving Brick Co., Galesburg, Ill	3½x4x8½	2.32	5.4	27.3	27.1	29.6	27.9
3357	Purington Paving Brick Co., Galesburg, Ill	..do	....	....	23.3	26.5	25.5	28.7
3367	Danville Brick Co., Danville, Ill	3½x4x8¾	2.36	3.1	16.2	*29.7	19.4	20.2
3368	Danville Brick Co., Danville, Ill	..do	2.33	2.8	29.1	18.2	26.9	*32.3
3395	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	1.3	16.7	18.2	20.9	19.3
3396	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	2.6	14.6	16.9	35.0	15.8
3397	Springfield Paving Brick Co., Springfield, Ill	..do	2.38	4.2	14.4	12.2	30.0	19.6
3398	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	1.9	20.7	23.5	17.8	17.2
3399	Springfield Paving Brick Co., Springfield, Ill	..do	2.38	2.4	18.8	15.5	20.1	16.0
3400	Springfield Paving Brick Co., Springfield, Ill	..do	2.38	2.9	16.1	15.3	17.8	18.7
3401	Barr Clay Co., Streator, Ill	3½x4x8½	2.36	1.9	16.3	17.1	16.2	16.9
3414	Springfield Paving Brick Co	3½x4x8¾	2.37	3.5	18.5	20.2	17.3	15.8
3415	Springfield Paving Brick Co	..do	2.40	2.5	20.0	22.0	18.1	19.5
3416	Albion Vitrified Brick Co., Albion, Ill	..do	2.39	1.8	16.5	17.7	22.1	18.2
3417	Albion Shale Brick Co., Albion, Ill	3½x4x8½	2.43	1.3	20.0	26.7	19.5	21.0
3418	Purington Paving Brick Co., Galesburg, Ill	..do	2.40	0.7	18.8	20.4	21.4	24.0
3419	Purington Paving Brick Co., Galesburg, Ill	..do	2.41	1.3	16.4	23.5	21.8	29.6
3425	Springfield Paving Brick Co., Springfield, Ill	3½x4x8¾	2.41	1.0	19.6	20.5	30.9	17.5
3426	Springfield Paving Brick Co., Springfield, Ill	..do	2.40	1.9	17.2	18.4	17.4	20.7
3427	Springfield Paving Brick Co., Springfield, Ill	..do	2.42	1.3	19.7	17.6	15.4	32.5
3428	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	2.4	18.3	20.6	17.8	21.9
3429	Albion Vitrified Brick Co., Albion, Ill	3½x4x8½	2.42	1.2	19.9	19.2	23.6	22.5
3440	Springfield Paving Brick Co., Springfield, Ill	3½x4x8¾	2.37	3.2	21.8	26.5	20.3	20.2
3441	Springfield Paving Brick Co., Springfield, Ill	..do	2.40	1.1	15.3	18.1	16.2	22.7
3442	Springfield Paving Brick Co., Springfield, Ill	..do	2.42	1.5	20.2	18.5	18.4	19.9
3443	Springfield Paving Brick Co., Springfield, Ill	..do	2.36	2.0	20.2	15.3	16.7	15.5
3444	Springfield Paving Brick Co., Springfield, Ill	..do	2.42	1.5	16.5	18.4	18.4	21.5
3445	Springfield Paving Brick Co., Springfield, Ill	..do	2.36	3.3	18.7	19.7	20.7	24.8
3452	Springfield Paving Brick Co., Springfield, Ill	..do	2.38	2.7	20.0	19.0	23.9	21.9
3453	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	2.2	23.3	18.9	21.2	20.4
3454	Springfield Paving Brick Co., Springfield, Ill	..do	2.36	3.0	14.9	14.9	*27.2	16.8
3455	Springfield Paving Brick Co., Springfield, Ill	..do	2.37	3.1	16.6	18.7	21.4	20.4
3458	Springfield Paving Brick Co., Springfield, Ill	..do	2.40	2.1	*34.1	20.9	23.9	23.8
3459	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	1.9	17.1	*27.3	21.6	19.5
3460	Springfield Paving Brick Co., Springfield, Ill	..do	2.38	2.4	21.9	17.6	21.3	23.0
3461	Springfield Paving Brick Co., Springfield, Ill	..do	2.40	2.3	17.1	17.6	20.5	20.7
3462	Springfield Paving Brick Co., Springfield, Ill	..do	2.40	1.8	16.4	21.2	16.0	18.6
3463	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	2.6	18.8	*26.3	21.4	25.1
3465	Springfield Paving Brick Co., Springfield, Ill	..do	2.39	1.7	16.0	19.4	16.2	19.2
3466	Springfield Paving Brick Co., Springfield, Ill	..do	2.37	2.0	18.1	17.0	21.7	20.6

* Bricks broken in rattler.

Continued.

Rattler test—loss in per cent by weight.							Remarks.	Place used.
Brick No. 5.	Brick No. 6.	Brick No. 7.	Brick No. 8.	Brick No. 9.	Brick No. 10.	Average.		
18.8	28.0	19.2	16.1	17.8	20.9	21.6	Dunn wire-cut lug brick	Section F, Kankakee County.
21.2	20.1	22.2	21.0	18.9	27.3	21.5	..do	Section F, Kankakee County.
35.9	22.7	22.5	24.1	35.7	32.6	30.0	..do	Culled bricks.
22.7	18.8	20.1	18.8	24.9	28.6	22.5	..do	Section I, Route 8, Sangamon County.
19.1	17.1	18.8	20.1	16.0	18.3	19.5	Repressed brick	City of Sterling, Whiteside County.
14.1	13.6	14.4	17.3	21.8	15.4	17.2	Dunn wire-cut lug brick	Section F, Edgar County.
13.9	*16.4	14.9	17.7	14.7	.....	16.1	..do	Section F, Edgar County.
14.8	*18.1	13.5	*25.4	23.6	*25.0	19.0	..do	Section F, Edgar County.
13.9	17.0	17.9	17.7	18.4	19.2	17.0	..do	Champaign County.
20.2	19.5	17.6	15.4	16.3	15.0	16.8	..do	Champaign County.
25.5	*35.0	27.2	*24.2	20.4	20.6	24.6	Repressed brick	Dixon Township, Lee County.
21.2	17.9	19.1	28.1	21.7	26.0	23.2	..do	Dixon Township, Lee County.
23.8	22.7	22.4	19.9	28.9	20.1	21.8	Hillside brick	Section C, Peoria County.
16.0	20.2	*40.0	18.9	17.0	*28.3	20.6	Dunn wire-cut lug brick	Stockland Township, Iroquois County.
26.9	23.0	26.0	29.0	27.7	29.0	27.3	Repressed brick	Farmington Road, Peoria County.
23.8	31.9	29.0	30.0	23.8	27.0	26.9	..do	Farmington Road, Peoria County.
26.6	20.7	16.6	16.4	20.3	14.3	20.0	Dunn wire-cut lug brick	Section F, Route 3, Champaign County.
17.7	16.6	*28.0	15.1	17.8	23.9	22.6	..do	Section F, Route 3, Champaign County.
17.2	21.2	16.5	19.0	20.4	16.2	18.5	..do	Section J, Route 3, Sangamon County.
20.8	22.6	17.9	20.9	17.7	20.8	20.3	..do	Section J, Route 3, Sangamon County.
19.7	19.1	17.4	18.2	30.4	16.3	20.4	..do	Section J, Route 3, Sangamon County.
*38.5	19.1	16.1	16.3	18.4	23.4	21.1	..do	Section J, Route 3, Sangamon County.
15.1	18.8	19.6	20.2	13.9	19.4	17.7	..do	Section J, Route 3, Sangamon County.
16.6	16.3	17.0	22.0	22.2	18.6	18.0	..do	Section J, Route 3, Sangamon County.
17.0	19.0	28.2	19.3	19.1	19.1	18.8	..do	Section E, LaSalle County.
19.1	28.1	15.4	16.9	21.3	17.3	18.8	..do	Section J, Route 3, Sangamon County.
15.3	20.8	21.4	16.7	23.3	23.6	20.1	..do	Section J, Route 3, Sangamon County.
*22.0	19.7	16.5	23.7	18.0	17.1	19.1	Repressed brick	City of Harrisburg, Saline County.
18.1	22.0	24.6	16.7	17.3	16.3	20.2	..do	City of Harrisburg, Saline County.
19.9	19.0	19.7	21.0	21.8	24.5	21.0	..do	Farmington Road, Peoria County.
27.2	20.0	23.8	23.2	19.6	23.8	22.9	..do	Farmington Road, Peoria County
35.1	29.6	20.0	22.9	21.4	18.2	23.6	Dunn wire-cut lug brick	Section H, Sangamon County.
21.9	17.1	21.7	16.3	*46.6	20.2	21.7	..do	Section H, Sangamon County.
23.0	18.4	22.0	18.4	21.9	17.7	20.6	..do	Section H, Sangamon County.
19.0	25.8	15.8	17.0	21.7	21.7	20.0	..do	Section H, Sangamon County.
19.4	15.5	15.7	16.3	18.1	22.6	19.3	Repressed brick	Section B, Route 3, Edwards County.
16.4	17.5	18.0	38.6	20.3	17.0	21.7	Dunn wire cut lug brick	Section H, Sangamon County.
17.7	15.9	20.5	23.7	17.2	19.4	18.7	..do	Section H, Sangamon County.
17.6	15.3	31.1	20.1	19.8	23.8	20.5	..do	Section H, Sangamon County.
25.2	17.0	16.2	29.3	21.8	23.6	20.1	..do	Section H, Sangamon County.
18.3	26.5	18.5	18.4	20.2	16.0	19.3	..do	Section H, Sangamon County.
18.2	17.4	17.8	19.4	13.7	*57.7	22.8	..do	Section H, Sangamon County.
21.0	17.6	16.4	14.8	25.2	17.4	19.7	..do	Section H, Sangamon County.
20.7	18.5	20.1	19.2	23.3	17.6	20.3	..do	Section H, Sangamon County.
*64.6	16.9	17.7	20.8	13.2	16.8	22.4	..do	Section H, Sangamon County.
21.6	16.8	23.2	18.3	19.8	17.2	19.4	..do	Section J, Sangamon County.
21.0	18.9	19.2	16.3	19.3	17.0	21.4	..do	Section J. Sangamon County.
24.6	23.6	27.5	19.8	17.8	22.8	22.1	..do	Section J, Sangamon County.
19.9	21.6	23.0	19.1	19.2	17.9	20.4	..do	Section J, Sangamon County.
20.4	17.9	21.7	17.8	21.7	18.1	19.3	..do	Section J, Sangamon County.
19.8	24.4	16.5	14.7	18.3	22.6	18.8	..do	Section H, Sangamon County.
16.4	18.7	20.7	17.2	16.6	23.7	20.5	..do	Section J, Sangamon County.
19.7	21.5	15.7	18.8	15.6	15.7	17.8	..do	Section H. Sangamon County.
20.8	19.0	22.0	19.9	15.9	20.6	19.5	..do	Section H, Sangamon County.

TABLE XIII—

Laboratory number.	Bricks sold or manufactured by—	Dimension of brick (inches).	Specific gravity.	Absorption in per cent.	Rattler test—loss in per cent of weight.			
					Brick No. 1.	Brick No. 2.	Brick No. 3.	Brick No. 4.
3467	Barr Clay Co., Streator, Ill.	3¾x4x8½	2.38	2.2	*28.4	17.8	18.9	19.5
3468	Barr Clay Co., Streator, Ill.	do	2.38	1.3	18.8	19.9	22.9	17.1
3469	Barr Clay Co., Streator, Ill.	do	2.40	1.6	20.8	20.9	18.8	18.1
3477	Springfield Paving Brick Co., Springfield, Ill.	do	2.42	1.6	*33.4	*24.0	23.0	21.1
3478	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	3.8	28.8	15.0	*40.1	20.9
3479	Springfield Paving Brick Co., Springfield, Ill.	do	2.37	2.0	15.1	20.9	20.6	16.7
3480	Springfield Paving Brick Co., Springfield, Ill.	do	2.41	2.0	16.6	*32.1	16.2	*20.3
3495	Springfield Paving Brick Co., Springfield, Ill.	do	2.35	3.6	*65.2	20.2	22.5	23.0
3496	Springfield Paving Brick Co., Springfield, Ill.	do	2.35	3.0	19.4	13.7	19.9	*35.2
3501	Springfield Paving Brick Co., Springfield, Ill.	do	2.42	1.2	13.8	19.0	16.3	19.7
3502	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	3.8	18.2	21.8	*39.8	18.3
3503	Springfield Paving Brick Co., Springfield, Ill.	do	2.36	3.6	15.9	*31.5	16.6	18.6
3504	Springfield Paving Brick Co., Springfield, Ill.	do	2.41	0.6	28.4	15.0	21.4	*30.4
3505	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	1.4	19.1	19.0	18.4	17.8
3506	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	2.2	18.0	20.7	14.7	16.8
3507	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	1.1	16.3	21.4	26.5	20.0
3514	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	2.3	19.5	20.2	20.1	17.7
3515	Springfield Paving Brick Co., Springfield, Ill.	do	2.41	0.8	17.1	18.0	24.3	17.3
3516	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	1.8	17.4	22.9	14.8	21.8
3517	Springfield Paving Brick Co., Springfield, Ill.	do	2.44	1.7	17.9	18.6	20.2	19.6
3525	Barr Clay Co., Streator, Ill.	3¼x4x8½	2.38	1.4	16.1	14.6	20.4	23.5
3526	Barr Clay Co., Streator, Ill.	do	2.39	2.0	20.1	20.7	20.9	19.4
3527	Springfield Paving Brick Co., Springfield, Ill.	3¾x4x8½	2.38	2.5	17.5	17.0	18.1	17.5
3528	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	2.5	18.2	19.6	18.3	16.9
3529	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	2.9	13.8	16.5	17.0	21.7
3530	Springfield Paving Brick Co., Springfield, Ill.	do	2.41	1.9	23.7	21.8	19.5	19.5
3531	Springfield Paving Brick Co., Springfield, Ill.	do	2.36	2.5	17.4	16.7	21.1	21.1
3538	Springfield Paving Brick Co., Springfield, Ill.	do	2.36	3.0	17.8	19.1	15.3	28.4
3539	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	2.2	24.3	20.4	20.7	22.0
3540	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	3.0	18.6	16.2	19.3	16.3
3541	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	2.0	16.8	*17.6	17.3	18.0
3542	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	1.5	16.4	18.4	16.9	19.9
3549	Springfield Paving Brick Co., Springfield, Ill.	do	2.37	3.7	16.8	19.6	15.1	18.3
3550	Springfield Paving Brick Co.	do	2.37	3.5	18.7	18.8	23.2	16.7
3551	Springfield Paving Brick Co., Springfield, Ill.	do	2.37	2.2	17.9	16.4	17.1	*54.6
3557	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	2.1	18.4	17.4	17.4	22.5
3558	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	2.1	30.6	19.6	20.1	20.6
3563	Springfield Paving Brick Co., Springfield, Ill.	do	2.36	3.9	22.0	*33.8	18.5	26.4
3564	Springfield Paving Brick Co., Springfield, Ill.	do	2.36	4.1	21.0	16.5	16.4	47.5
3565	Springfield Paving Brick Co., Springfield, Ill.	do	2.38	2.4	18.1	22.6	18.9	19.2
3566	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	2.5	16.5	32.9	20.1	20.6
3573	Springfield Paving Brick Co., Springfield, Ill.	do	2.38	3.3	16.8	18.8	18.1	19.7
3574	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	1.8	22.5	20.4	14.6	18.2
3577	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	2.5	20.6	16.7	21.1	*28.5
3578	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	2.1	23.2	19.4	17.2	17.6
3579	Springfield Paving Brick Co., Springfield, Ill.	do	2.42	1.3	15.8	16.1	19.0	16.9
3605	Springfield Paving Brick Co., Springfield, Ill.	do	2.42	7.6	25.9	23.7	21.8	16.5
3606	Springfield Paving Brick Co., Springfield, Ill.	do	2.38	3.6	27.4	19.1	16.8	19.1
3607	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	2.2	20.8	17.5	15.5	15.7
3608	Springfield Paving Brick Co., Springfield, Ill.	do	2.42	0.9	16.4	16.1	17.4	17.5
3609	Springfield Paving Brick Co., Springfield, Ill.	do	2.41	1.2	15.7	19.8	16.8	18.4
3610	Springfield Paving Brick Co., Springfield, Ill.	do	2.41	2.0	18.8	19.5	15.7	18.7
3611	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	2.0	21.0	17.8	20.0	18.8
3647	Springfield Paving Brick Co., Springfield, Ill.	3¼x4x8½	2.39	2.3	16.5	19.8	25.7	24.7
3648	Springfield Paving Brick Co., Springfield, Ill.	do	2.37	3.2	20.3	17.1	21.4	28.1
3649	Springfield Paving Brick Co., Springfield, Ill.	do	2.39	2.3	18.1	18.3	*21.6	17.7
3650	Springfield Paving Brick Co., Springfield, Ill.	do	2.40	3.0	*30.8	18.1	20.4	20.0
3651	Springfield Paving Brick Co., Springfield, Ill.	do	2.38	2.6	16.5	16.7	24.3	16.2
3669	F. R. Carter, Peoria, Ill.	3½x4x8½	2.37	1.5	19.0	18.7	16.3	18.6

* Bricks broken in rattler.

Concluded.

Rattler test—loss in per cent by weight.							Remarks.	Place used.
Brick No. 5.	Brick No. 6.	Brick No. 7.	Brick No. 8.	Brick No. 9.	Brick No. 10.	Average.		
18.3	20.7	20.0	22.7	21.0	19.0	20.6	Dunn wire-cut lug brick	Section A, Route 9, LaSalle County.
19.3	16.5	18.0	20.5	19.3	19.4	19.2	..do	Section A, Route 9, LaSalle County.
21.8	17.3	24.0	17.3	19.5	20.9	19.9	..do	Section A, Route 9, LaSalle County.
*19.4	17.9	16.7	15.7	21.2	15.9	20.8	..do	Section J, Sangamon County.
18.1	21.6	16.2	16.4	23.2	23.2	22.3	..do	Section J, Sangamon County.
24.4	19.1	18.9	17.9	*34.5	18.3	20.6	..do	Section H, Sangamon County.
*20.1	16.0	18.3	18.2	*23.4	17.7	19.9	..do	Section H, Sangamon County.
*27.2	19.5	17.7	18.6	17.0	17.3	24.8	..do	Section H, Sangamon County.
17.2	15.1	*20.8	24.6	19.3	22.3	20.7	..do	Section H, Sangamon County.
17.6	19.1	18.0	20.1	18.4	21.2	18.3	..do	Section J, Sangamon County.
19.1	17.6	16.4	20.4	26.7	13.9	21.1	..do	Section H, Sangamon County.
25.1	*30.8	21.9	20.8	21.5	15.0	21.8	..do	Section H, Sangamon County.
19.4	27.3	14.8	19.7	14.6	19.2	21.0	..do	Section H, Sangamon County.
20.1	*20.2	18.6	13.5	*22.5	19.3	18.8	..do	Section H, Sangamon County.
21.0	19.8	18.4	*24.4	22.6	18.6	19.5	..do	Section J, Sangamon County.
18.8	20.4	18.0	29.0	21.9	21.2	21.3	..do	Section H, Sangamon County.
19.3	38.2	18.0	16.7	22.4	20.8	21.3	..do	Section H, Sangamon County.
17.1	15.9	14.9	16.8	15.4	*20.2	17.7	..do	Section H, Sangamon County.
*24.6	17.0	22.7	19.4	15.9	17.5	19.4	..do	Section H, Sangamon County.
17.5	19.2	*31.6	14.0	15.8	20.7	19.5	..do	Section H, Sangamon County.
21.6	17.0	19.3	17.9	19.3	16.3	18.6	..do	Section F, Route 6, LaSalle County.
28.0	17.0	21.7	20.0	19.8	21.8	21.9	..do	Section F, Route 6, LaSalle County.
19.7	16.0	16.6	*16.2	*32.6	22.6	19.4	..do	Section J, Sangamon County.
17.7	17.0	17.9	19.1	22.9	20.2	18.8	..do	Section J, Sangamon County.
19.7	13.4	18.3	19.1	22.6	21.9	18.5	..do	Section H, Sangamon County.
37.0	20.9	*25.0	13.9	*27.5	16.8	22.5	..do	Section J, Sangamon County.
22.4	19.8	19.5	18.3	16*4	16.5	18.9	..do	Section J, Sangamon County.
19.4	16.5	17.3	22.2	19.0	17.5	19.2	..do	Section H, Sangamon County.
23.9	18.5	17.5	17.1	17.1	14.9	19.6	..do	Section H, Sangamon County.
17.3	21.0	18.4	16.8	16.9	15.8	17.5	..do	Section H, Sangamon County.
17.0	18.5	20.4	16.3	16.4	20.3	17.8	..do	Section H, Sangamon County.
19.8	20.0	13.8	19.1	17.8	37.1	19.9	..do	Section H, Sangamon County.
22.4	18.7	24.3	15.4	18.2	20.4	18.9	..do	Section J, Sangamon County.
18.4	17.6	19.6	14.3	19.6	18.8	18.5	..do	Section J, Sangamon County.
15.7	20.4	18.3	18.5	21.2	14.7	21.4	..do	Section J, Sangamon County.
16.7	17.7	19.2	22.2	18.8	19.1	18.9	..do	Section J, Sangamon County.
23.7	20.8	18.0	19.1	18.7	22.6	21.3	..do	Section J, Sangamon County.
17.7	22.9	19.3	19.8	24.9	18.4	22.3	..do	Section J, Sangamon County.
15.8	18.2	15.0	15.9	15.4	23.0	20.5	..do	Section J, Sangamon County.
18.9	18.3	23.3	20.2	18.5	20.7	19.9	..do	Section J, Sangamon County.
*25.2	18.1	20.5	25.8	19.5	23.6	22.2	..do	Section J, Sangamon County.
16.0	26.4	22.1	16.8	20.0	19.8	19.4	..do	Section J, Sangamon County.
19.7	28.1	19.0	21.8	17.1	16.7	19.8	..do	Section J, Sangamon County.
23.8	16.1	21.4	22.7	19.3	22.4	21.2	..do	Section J, Sangamon County.
19.0	19.6	21.1	23.1	16.4	15.2	19.2	..do	Section J, Sangamon County.
18.4	16.0	15.4	16.0	20.0	20.6	17.4	..do	Section J, Sangamon County.
*35.1	19.5	19.4	26.6	*25.8	16.9	23.1	..do	Culled bricks.
19.7	17.1	32.7	17.7	18.6	26.2	21.4	..do	Section G, Sangamon County.
16.5	14.0	14.9	16.5	20.3	15.9	16.8	..do	Section G, Sangamon County.
16.4	19.6	15.6	25.9	16.6	21.9	18.3	..do	Section G, Sangamon County.
17.2	18.4	19.4	14.8	16.0	15.4	17.2	..do	Section G, Sangamon County.
21.5	16.4	20.8	16.1	21.2	25.4	19.4	..do	Section J, Sangamon County.
17.5	18.2	22.1	27.8	20.6	17.8	20.1	..do	Section J, Sangamon County.
20.8	14.2	20.1	19.8	18.7	16.0	19.6	..do	Section J, Sangamon County.
17.6	19.3	16.8	18.2	20.0	15.7	19.4	..do	Section J, Sangamon County.
21.0	24.6	19.4	17.5	20.3	26.5	20.5	..do	Section J, Sangamon County.
16.7	17.6	18.1	21.0	18.3	16.7	19.8	..do	Section J, Sangamon County.
18.9	17.4	22.6	22.2	14.7	20.8	19.0	..do	Section J, Sangamon County.
16.8	21.7	18.2	18.9	27.7	17.0	19.3	Repressed brick	Manufacturer's sample.

TABLE XIV—PHYSICAL TESTS OF ROCKS—1914.

Laboratory number.	Quarry.	Company furnishing stone.	Specific gravity.	Weight per cubic foot—pounds.	Water absorbed per cubic foot—pounds.	Per cent of wear.	French coefficient of wear.	Toughness.	Remarks.
566	Grafton, Ill	Grafton Quarry Co	2.48	155	10.1	7.7	5.2	.....	
570	Joliet, Ill	Western Stone Co	2.75	171.5	1.01	3.2	12.5	.....	
571	Elsah, Ill	Western Whiting & Mfg. Co	2.66	166	1.78	5.9	6.8	.....	
572	Joliet, Ill	National Stone Co	2.76	172	1.99	5.0	8.0	.....	No. 1 Stone.
573	Joliet, Ill	..do	2.70	168.5	3.16	5.4	7.4	.....	No. 2 Stone.
578	Chicago, Ill	Chicago Union Lime Works	2.75	171.5	2.60	3.7	10.8	.....	
579	Kankakee, Ill	Lehigh Stone Co	2.68	167	3.7	2.5	16.0	.....	Round stones only. Not fair sample.
580	Alton, Ill	Reliance Quarry & Construction Co	2.65	165	2.6	3.8	10.5	.....	
583	Alton, Ill	Lockyer Quarry Co	2.69	168	0.72	4.9	8.2	.....	
584	East St. Louis, Ill	East St. Louis Stone Co	2.70	168.5	0.43	5.0	8.0	.....	
587	Gary, Ill	Dolese & Shepard Co	2.78	173	0.94	3.9	10.2	.....	
588	Kankakee, Ill	McLaughlin Mateer Co	2.63	164	2.2	6.0	6.7	.....	
589	LaGrange, Ill	Superior Stone Co	2.61	163	3.5	5.8	6.9	.....	
590	Marion, Ill	The Charles Stone Co	2.69	168	0.71	4.4	9.1	8	
592	East St. Louis, Ill	Casper-Stolle Quarry & Construction Co	2.69	168	0.50	4.0	10.0	.....	
603	Elmhurst, Ill	Elmhurst-Chicago Stone Co	2.68	167	1.9	4.9	8.2	.....	
605	McCook, Ill	U. S. Crushed Stone Co	2.75	171.5	1.14	5.7	7.0	6	
621	Grafton, Ill	Grafton Quarry Co	2.51	157	4.6	6.1	6.6	8	
634	Alton, Ill	Mississippi Sand Co	2.71	169	0.31	3.3	12.1	.....	
670	Kankakee, Ill	McLaughlin, Cook & Co	2.63	164	2.0	6.8	5.9	.....	
673	Thornton, Ill	Brownell Improvement Co	2.69	168	2.2	5.8	6.9	.....	
676	East St. Louis, Ill	Casper Stolle Quarry & Construction Co	2.70	168.5	0.30	5.0	8.0	9	
694	Joliet, Ill	National Stone Co	2.69	168	1.1	3.7	10.8	7	
709	McCook, Ill	U. S. Crushed Stone Co	2.70	168.5	1.8	5.1	7.9	9	
710	McCook, Ill	..do	2.70	168.5	1.0	6.3	6.4	7	
711	McCook, Ill	..do	2.75	172	0.8	5.6	7.2	8	
720	Thornton, Ill	Brownell Improvement Co	2.65	165	1.5	5.3	7.5	7	
724	McCook, Ill	U. S. Crushed Stone Co	2.68	167	1.6	5.5	7.3	.....	
734	Mitchell, Ind	The Mitchell Lime Co	2.71	169	0.9	3.9	10.2	.....	
739	Lyons, Ill	Riverside Lime and Stone Co	2.50	156	3.4	6.0	6.7	7	
740	Joliet, Ill	Ideal Stone Co	2.72	170	1.2	5.1	7.9	13	
754	Bellwood, Ill	A. C. O'Laughlin Stone Co	2.61	163	3.4	5.0	8.0	.....	
755	Oregon, Ill		2.74	171	1.6	5.8	6.9	.....	
761	Blue Island, Ill	Franklin Stone Co	2.65	165	2.6	4.6	8.7	.....	
762	Lemont, Ill	Illinois Stone Co	2.65	165	1.8	4.1	9.8	5	
776	Greencastle, Ind	Ohio & Indiana Stone Co	2.67	167	0.78	3.4	11.7	8	
785	Riverside, Ill	Riverside Lime & Stone Co	2.65	165	2.4	4.9	8.2	.....	
789	Kankakee, Ill	Lehigh Stone Co	2.66	166	2.4	4.0	10.0	.....	

827	Freeport, Ill	Sanford & Zartman Lumber Co	2.64	165	2.7	15.9	2.5	13	
864	Elhurst, Ill	Elmhurst-Chicago Stone Co	2.69	168	2.4	5.2	7.7	6	
883	McCook, Ill	U. S. Crushed Stone Co	2.67	167	1.2	4.8	8.3	.....	
905	Joliet, Ill	National Stone Co	2.66	166	0.80	4.0	10.0	.....	
908	Alton, Ill	Reliance Quarry & Construction Co	2.68	167	0.65	5.2	7.7	6	
910	Quincy, Ill	F. W. Menke Stone Co	2.54	158	2.2	5.5	7.3	6	
913	Kenneth, Ind	Casparis Stone Co	2.69	168	0.72	4.2	9.5	6	
914	Quincy, Ill	Wm. D. Meyer Stone Co	2.63	164	1.0	7.7	5.2	6	
924	Lemont, Ill	Universal Crushed Stone Co	2.74	171	0.53	5.4	7.4	.....	
932	Quincy, Ill	Wm. D. Meyer Stone Co	2.61	163	1.9	7.2	5.5	6	
933	Quincy, Ill	F. W. Menke Stone Co	2.60	162	2.0	6.9	5.8	6	
945	Alton, Ill	Reliance Quarry & Construction Co	2.67	167	1.1	3.7	10.8	.....	
974	Joliet, Ill	Joliet Artificial Stone Co	2.76	172	1.1	5.0	8.0	10	
991	Buffalo, Ia	Dolese Bros. Co	2.64	165	2.0	7.6	5.3	5	
1013	Columbia, Ill	Columbia Quarries Co	2.60	162	2.1	5.0	8.0	7	
1021	Elsah, Ill	Western Whiting & Mfg. Co	2.67	167	0.52	6.4	6.3	6	
1030	Alton, Ill	Harry Gissal Quarry Co	2.68	167	0.56	4.3	9.3	7	
1033	Greencastle, Ind	A. & C. Stone & Lime Co	2.65	165	0.78	4.4	9.1	6	
1043	Robinson, Ill	Farmer's Limestone Milling Co	2.68	167	1.9	5.7	7.0	8	Top layer.
1044	Robinson, Ill	Farmer's Limestone Milling Co	2.71	169	0.63	5.4	7.4	10	Bottom layer.
1049	Sullivan, Ill	J. C. Shields, Sullivan	2.79	174	0.9	9.3	4.3	.....	
1062	Rockford, Ill	The Carrico Stone Co	2.70	168	2.3	5.8	6.9	7	
649	Joliet, Ill	Joliet Sand & Gravel Co	2.66	166	2.8	3.3	12.1	.....	Crushed gravel.

TABLE XV—PHYSICAL TESTS OF ROCK—1915.

Laboratory number.	Quarry.	Furnished by—	Specific gravity.	Weight per cubic foot.	Water absorbed per cubic foot.	Wear in per cent.	French coefficient of wear.	Toughness.
1110	Anna, Ill	C. F. Massey Co., Anna, Ill	2.69	167	0.82	3.9	10.2	18.0
1119	Not given	Submitted by G. T. Austin, Effingham, Ill	2.70	168	0.87	6.5	6.1	9.0
1122	Logansport, Ind	Submitted by J. E. Sankey & Co., Springfield, Ill	2.70	168	0.17	4.9	8.1	7.0
1156	Greencastle, Ind	A. & C. Stone & Lime Co., Greencastle, Ind	2.70	168	0.47	4.4	9.1	.....
1168	Calhoun County, Ill	Submitted by M. W. Watson, Springfield, Ill	2.67	166	0.67	6.1	6.6	7.0
1182	Joliet, Ill	State Penitentiary, Joliet, Ill	2.71	169	1.72	4.0	10.0	10.0
1200	Grafton, Ill	Grafton Quarry Co., Grafton, Ill	2.49	155	5.38	6.4	6.2	6.0
1225	East St. Louis, Ill	Hill-Thomas Lime & Cement Co., East St. Louis, Ill	2.68	167	0.50	5.6	7.1	7.0
1244	Joliet, Ill	National Stone Co., Joliet, Ill	2.72	172	0.89	3.8	10.5	.....
1280	East St. Louis, Ill	Hill-Thomas Lime & Cement Co., East St. Louis, Ill	.....	.....	.....	4.2	9.5	.....
1335	Linwood Quarry, Scott Co., Ia	N. E. Keeler Co., Davenport, Ia	2.63	164	2.10	6.7	6.0	6.0
1416	Scales Mound, Ill	Submitted by W. B. Alexander, Chicago, Ill	2.71	169	1.37	6.3	6.4	6.0
1420	Casey, Ill	A. & C. Stone & Lime Co., Greencastle, Ind	2.68	167	0.80	4.5	8.9	.....

TABLE XV—Concluded.

Laboratory number.	Quarry.	Furnished by—	Specific gravity.	Weight per cubic foot.	Water absorbed per cubic foot.	Wear in per cent.	French coefficient of wear.	Toughness.
1478	Calhoun County, Ill	Submitted by J. A. Earley, Batchtown, Ill	2.67	166	0.83	7.6	5.2	5.0
1532	W. Ehrler Quarry, Warren, Ill	Submitted by W. Ehrler, Galena, Ill	2.73	170	1.15	5.6	7.1	7.0
1548	Garden Prairie Quarry	Submitted by C. L. Tryon, Woodstock, Ill	2.66	166	2.80	7.2	5.5	8.0
1558	Galena, Ill	Galena Limestone Co., Galena, Ill	2.70	168	1.45	7.1	5.6	.....
1559	Ottawa, Ill	Ottawa Stone & Sand Co., Ottawa, Ill	2.73	170	0.58	4.4	9.1	7.0
1564	Not given	Submitted by J. E. Sankey, Springfield, Ill	2.70	168	1.12	4.9	8.2	9.0
1573	Kankakee, Ill	Lehigh Stone Co., Kankakee, Ill	2.63	164	2.87	3.7	10.8	.....
1598	Garden Prairie Quarry	Submitted by C. L. Tryon, Woodstock, Ill	2.82	176	0.44	5.5	7.3	9.0
1602	Oregon, Ill	Submitted by F. O. Lowden, Oregon, Ill	2.72	169	1.88	5.6	7.1	8.0
1630	Not given	Submitted by Logan:Gertz Construction Co., Elgin, Ill	2.80	174	0.75	5.1	7.8	.....
1708	Kankakee, Ill	Lehigh Stone Co., Kankakee, Ill	2.65	165	2.33	4.7	8.5	.....
1718	Logansport, Ind	Logansport Stone & Construction Co., Huntington, Ind	2.77	172	0.69	3.4	11.7	6.0
1739	Dixon, Ill	C. R. Leake, Dixon, Ill	2.70	168	2.00	7.7	5.2	6.0
1786	Not given	Brownell Improvement Co., Chicago, Ill	2.64	164	1.90	.....	.....	9.0
1789	Columbia, Ill	Columbia Quarry Co., St. Louis, Mo	2.64	164	1.47	3.6	11.1	8.0

TABLE XVI—PHYSICAL TESTS OF ROCKS—1916.

Laboratory number.	Quarry.	Furnished by—	Specific gravity.	Weight per cubic foot in pounds.	Water absorbed per cubic foot in pounds.	Wear in per cent.	French coefficient of wear.	Toughness.	Remarks.
1827	Smelter Slag from Aurora, Ill	Submitted by G. N. Lamb, County Superintendent of Highways, Geneva, Ill.	2.58	161	2.05	2.7	14.8	.....	
1835	Plymouth, Ill	Submitted by John T. Wilson, Plymouth, Ill.	2.60	162	1.98	5.3	7.5	7	
1842	Thornton, Ill	Brownell Improvement Co., Chicago, Ill.	2.61	163	3.43	4.5	8.8	7	Producer's sample.
1854	Near Athens, Ill	Submitted by R. Y. Kincaid, Athens, Ill	2.62	163	1.62	5.7	7.0	6	
1890	Romeo, Ill	Joliet Crushed Stone Co., Joliet, Ill	2.59	161	4.0	5.0	8.0	7	

1897	Belvidere, Ill	Boone County Electric Stone Co., Belvidere, Ill.	2.71	169	1.88	6.8	5.9	7	
1910	Eldred, Ill	Submitted by John Brogan, Eldred, Ill.	2.65	165	0.56	6.3	6.3	7	
1927	Buffalo, Ia	Dolese Bros. Co., Buffalo, Ia	2.64	165	1.24	7.6	5.3	11	
1944	Quincy, Ill	Marblehead Lime Co., Quincy, Ill.	2.66	166	1.32	6.3	6.3	9	
1966	Ledge near Kankakee River two miles below Warner Bridge.	Submitted by F. M. Enos, County Superintendent of Highways, Kankakee, Ill.	2.69	167	0.45	5.0	8.0	6	
2021	Ledge one mile from Warner Bridge	do	2.69	167	0.57	5.6	7.1	6	Rock in thin strata of ¼ inch to 1½ inches in thickness.
2025	Griggsville, Ill	Submitted by Cameron, Joyce & Co., Keokuk, Ia.	2.63	164	1.0	7.1	5.7	8	Rock of uniform texture.
2035	Union, Ill	Farmers Limestone Milling Co., Robinson, Ill.	2.71	169	0.60	3.7	10.8	12	Sample from ledge 7 feet deep.
2084	Joliet, Ill	National Stone Co., Joliet, Ill.	2.70	168	1.25	4.6	8.6	12	
2100	Elmhurst, Ill	Elmhurst-Chicago Stone Co., Elmhurst, Ill.	2.68	167	2.0	4.1	9.8	7	
2143	Freeport, Ill	Sanford & Zartman Lumber Co., Freeport, Ill.	2.64	165	2.5	12.6	3.2	.....	Siliceous limestone.
2191	West Side Quarry, Kankakee, Ill	West Side Quarry, Kankakee, Ill.	2.54	158	2.6	9.5	4.2	6	Yellow surface rock.
2192	West Side Quarry, Kankakee Ill	do	2.64	165	2.9	6.5	6.2	8	Bottom rock.
2219	Thornton, Ill	Brownell Improvement Co., Chicago, Ill.	2.71	169	0.63	6.8	5.9	.....	Material used as first course stone. Sec. C Iroquois County.
3027	Thornton, Ill	do	.....	.....	.....	5.4	7.4	.....	80 pieces required for abrasion test instead of standard 50 pieces.
3028	Thornton, Ill	do	.....	.....	.....	4.5	8.9	.....	67 pieces required for abrasion test instead of standard 50 pieces.
3047	City Quarry, Dixon, Ill	W. H. Rink, Dixon, Ill	2.69	167	2.86	7.0	5.7	12	
3093	Greencastle, Ind	A. & C. Stone Co., Greencastle, Ind	2.69	168	0.60	5.1	7.9	.....	
3095	Kankakee, Ill	Submitted by F. C. Feutz, Danville, Ill.	.....	.....	.....	4.5	8.9	.....	62 pieces required for abrasion test instead of standard 50 pieces.
3112	Thornton, Ill	Brownell Improvement Co., Chicago, Ill.	.....	.....	.....	5.0	8.0	.....	85 pieces required for abrasion test instead of standard 50 pieces.
3117	Saline Quarry, Grantfork, Ill	Stocker Gravel and Construction Co., Highland, Ill.	2.70	168	1.10	3.8	10.5	12	Sample from W. E. Howden, Edwardsville, Ill.
3147	Elmhurst, Ill	Elmhurst-Chicago Stone Co., Elmhurst, Ill.	2.69	168	2.10	5.4	7.4	.....	
3149	Joliet, Ill	National Stone Co., Joliet, Ill.	2.76	172	0.85	4.2	9.5	.....	
3151	1,000 feet south of Station 94, Sec. B, Calhoun County.	Submitted by S. F. Wilson, Hardin, Ill.	2.65	165	1.25	5.7	7.0	8	
3171	Thornton, Ill	Brownell Improvement Co., Chicago, Ill.	2.61	163	3.0	7.0	5.7	7	Material used as first course stone, Sec. C, Iroquois County.
3217	Thornton, Ill	do	2.66	166	.....	5.0	8.0	9	57 pieces taken for abrasion test. Sample from G. A. Quinlan, Chicago, Ill.
3282	Thornton, Ill	do	2.60	162	2.08	5.5	7.3	7	Sample received from F. C. Feutz, Danville, Ill.
3372	Rankin Stone, Logan County	Submitted by T. S. Davy, County Superintendent of Highways, Lincoln, Ill.	2.63	164	3.45	.....	.....	7	Sample too small for complete tests.
3373	Rankin Stone, Logan County	do	2.60	162	4.1	.....	.....	5	Sample too small for complete tests.
3374	Rankin Stone, Logan County	do	2.66	166	1.07	6.2	6.4	6	

TABLE XVI—Concluded.

Laboratory number.	Quarry.	Furnished by—	Specific gravity.	Weight per cubic foot in pounds.	Water absorbed per cubic foot in pounds	Wear in per cent.	French coefficient of wear.	Toughness	Remarks.
3419	Kentland, Ind	Newton County Stone Co., Kentland, Ind.	2.70	168	0.37	5.1	7.8	10	
3491	Kankakee, Ill	Lehigh Stone Co., Kankakee, Ill	2.69	168	0.79	5.2	7.7	.....	66 pieces required for abrasion test instead of standard 50 pieces.
3492	Kankakee, Ill	..do	2.64	164	1.47	4.9	8.7	.....	
3493	Kankakee, Ill	..do	2.59	161	2.03	8.4	4.7	.....	
3494	Kankakee, Ill	..do	2.60	162	2.52	4.6	8.7	.....	86 pieces required for abrasion test instead of standard 50 pieces.
3545	Bellwood, Ill	A. C. O'Laughlin Co., Chicago, Ill	2.67	166	2.37	6.6	6.1	.....	Sample received from H. C. Peterson, Park Ridge, Ill.
3652	.....	Submitted by R. E. Thomas, Freeport, Ill.	2.72	169	1.3	6.1	6.6	6	
3658	Thornton, Ill	Brownell Improvement Co., Chicago, Ill.	2.63	164	1.98	7.1	5.6	8	Sample received from J. R. Goetzman, Vandalia, Ill.
3659	Near Mississippi River in Rock Island, Ill.	Submitted by C. E. Sikes, Hampton, Ill..	2.58	161	1.4	9.7	4.1	8	Yellow top rock.
3671	Logan County, Ill	Submitted by T. S. Davy, County Superintendent of Highways, Lincoln, Ill.	2.67	166	1.5	4.8	8.3	7	
3707	Old Quarry in Adams County, Ill	Submitted by L. L. Boyer, County Superintendent of Highways, Quincy, Ill.	2.65	165	1.0	5.8	6.9	7	

TABLE XVII—TESTS OF

Laboratory number.	Pit.	Furnished by—	Submitted by—	Nature of material.
532	Attica, Ind.	Attica Gravel Co.	Attica Gravel Co.	Mainly silicious grains.
535		Montezuma Sand, Gravel & Timber Co.	Edwin White, C. S. H.	Mixed materials.
537	Local pit, near Moose-heart road.		J. Johnson, Aurora	do.
538	Local pit, near Moose-heart road.		do.	do.
540	Six miles north of St. Charles.	Richardson Sand Co.	do.	do.
541	Vincennes, Ind.		Edwin White, C. S. H.	do.
542			do.	do.
548	Moronts, Ill.	Lakin Bros.	R. W. Osborn, C. S. H.	Mainly limestone.
549	Moronts, Ill.	do.	do.	do.
550	Moronts, Ill.	do.	do.	do.
551	Moronts, Ill.	do.	do.	Mainy fine quartz.
552	Moronts, Ill.	do.	do.	Mainly limestone.
553	Moronts, Ill.	do.	do.	Mainly fine quartz.
554	Yorkville, Ill.	H. O. Conkey Sand & Gravel Co.	John Johnson Aurora	Mixed materials.
555	Yorkville, Ill.	do.	do.	do.
558	Lincoln, Ill.	Lincoln Sand & Gravel Co.	Lincoln Sand & Gravel Co.	do.
574	Beloit, Wis.	Atwood-Davis Sand Co.	Atwood-Davis Sand Co.	A large per cent of quartz.
575	Beloit, Wis.	do.	do.	Mixed materials, a large per cent of limestone.
576	Beloit, Wis.	do.	do.	do.
577	Beloit, Wis.	do.	do.	do.
581		A. W. Lehrke & Co., Oregon, Ill.	A. W. Lehrke & Co., Oregon, Ill.	Mixed materials.
582		do.	do.	do.
585	Evansville, Ind.	Bedford & Nugent	Bedford & Nugent	Mainly fine silica.
586	Evansville, Ind.	do.	do.	Silicious materials.
591	Terre Haute, Ind.	Summit Sand & Gravel Co.	Summit Sand & Gravel Co.	Mixed materials.
593	Terre Haute, Ind.	Wabash Sand & Gravel Co.	Wabash Sand & Gravel Co.	do.
594	Terre Haute, Ind.	do.	do.	do.
595	East Peoria, Ill.	Peoria Washed Sand & Gravel Co.	Peoria Washed Sand & Gravel Co.	do.
596	East Peoria, Ill.	do.	do.	do.
597	East Peoria, Ill.	do.	do.	do.
598	East Peoria, Ill.	do.	do.	do.
599	Evansville, Ind.	Evansville Sand & Gravel Co.	Evansville Sand & Gravel Co.	Mainly fine silica.
600	Evansville, Ind.	do.	do.	Mixed silicious materials.
607	Walker Pit, Vandalia, Ill.		M. W. Watson, Vandalia.	Mixed materials.
608	Shanker Pit, Vandalia, Ill.		do.	do.
609	Kaskaskia River, Vandalia, Ill.		Ed. Huber, Vandalia	do.
610	Bank Gravel.		do.	do.
611			F. M. Enos, C. S. H., Kankakee.	do.
614	Mt. Carmel, Ill.	Mt. Carmel Elevator Co.	Mt. Carmel Elevator Co.	do.

SAND AND GRAVEL—1914.

Sieve analysis.												Clay and organic loam in sand, dry basis in per cent.	Tensile strength of mortar of 1 part cement and 3 parts sand in per cent of the tensile strength of mortar obtained with 1 part of the same cement and 3 parts of standard Ottawa sand.			Remarks.
Per cent passing 2½ inch sieve.	Per cent passing 2 inch sieve.	Per cent passing 1½ inch sieve.	Per cent passing 1¼ inch sieve.	Per cent passing 1 inch sieve.	Per cent passing ¾ inch sieve.	Per cent passing ½ inch sieve.	Per cent passing ⅜ inch sieve.	Per cent passing ¼ inch sieve.	Per cent passing ⅛ inch sieve.	Per cent passing 1-16 inch sieve.	Per cent passing 1-50 inch sieve.		Age, 7 days.	Age, 28 days.	Age, 90 days.	
.....	....	....	....	....	....	....	....	100	82	....	5	0.7	146	144	134	Sold as No. 1, washed sand.
.....	....	100	....	....	....	....	....	75	....	....	....	4.0	.....	.....	.....	Bridge work.
.....	....	100	....	....	....	80	....	58	34	18	3	4.0	.....	.....	.....	
.....	....	....	....	....	....	....	100	....	78	55	7	1.2	.....	.....	.....	
.....	....	....	....	....	....	....	100	....	76	56	6	1.5	.....	.....	.....	
.....	....	100	....	....	....	....	....	48	....	....	....	1.2	.....	.....	.....	
.....	....	....	....	....	100	....	....	61	....	....	....	2.3	.....	.....	.....	
.....	....	100	....	....	91	....	....	4	....	....	....	....	.....	.....	.....	Sold as washed concrete gravel.
.....	....	....	....	....	....	....	....	98	54	....	4	2.0	165	149	150	Sold as washed roofing gravel.
.....	....	100	....	....	87	....	....	5	....	....	....	....	.....	.....	.....	Sold as unwashed gravel.
.....	....	....	....	....	....	....	....	....	....	97	38	1.0	.....	.....	.....	Sold as unwashed cushion sand.
.....	....	....	....	....	....	....	100	....	7	....	....	1.7	140	119	126	Sold as torpedo sand.
.....	....	....	....	....	....	....	....	....	100	88	11	0.5	90	98	96	Building sand.
.....	....	100	....	....	60	....	....	0	....	....	....	....	.....	.....	.....	.
.....	....	....	....	....	....	....	....	95	79	....	15	2.0	143	137	134	
.....	....	....	....	....	....	....	100	....	93	75	3	0.5	102	94	99	
.....	....	....	....	....	....	....	....	97	83	67	8	0.3	114	104	122	No. 2 torpedo sand.
.....	....	....	....	....	100	83	....	12	....	....	....	....	.....	.....	.....	No. 6 gravel.
.....	....	100	....	90	41	6	....	....	....	....	....	....	.....	.....	.....	No. 8 gravel.
.....	100	72	....	2	....	....	....	....	....	....	....	....	.....	.....	.....	No. 9 gravel.
.....	....	....	....	....	....	....	....	98	90	69	4	0	110	122	117	Washed river sand.
.....	....	100	....	....	55	....	....	1	....	....	....	....	.....	.....	.....	Washed river gravel.
.....	....	....	....	....	....	....	....	100	98	90	15	0.3	94	90	84	
.....	....	100	....	....	81	....	....	10	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	100	99	....	64	41	25	1	1.2	139	131	133	
.....	....	....	....	....	....	98	....	68	47	24	1.5	1.0	.....	.....	.....	Binder gravel.
.....	....	100	....	97	92	80	....	54	36	20	1.5	0.7	.....	.....	.....	Binder gravel.
.....	....	....	....	....	....	....	....	100	93	72	11	0.6	124	117	121	
.....	....	....	....	....	....	100	....	58	4	....	....	....	.....	.....	.....	
.....	....	100	....	67	44	7	....	....	....	....	....	....	.....	.....	.....	
.....	....	100	....	73	60	48	....	13	0	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	....	....	100	99	95	10	0.6	94	81	79	
.....	....	100	....	....	95	57	....	17	7	....	....	....	.....	.....	.....	
.....	....	....	....	100	99	97	....	80	60	46	17	5.0	133	133	141	
.....	....	....	....	100	99	97	....	81	64	49	7	1.7	129	121	112	
.....	....	....	....	....	100	99	....	96	82	57	8	2.0	88	88	89	
.....	....	100	....	98	95	88	....	75	60	43	11	3.5	146	127	140	
.....	100	98	....	93	92	89	....	77	63	41	2	1.3	139	133	150	
.....	....	....	....	....	....	....	....	....	100	96	1	0.6	79	76	80	River sand.

TABLE XVII—

Laboratory number.	Pit.	Furnished by—	Submitted by—	Nature of material.
615	Mt. Carmel, Ill.	Mt. Carmel Elevator Co.	Mt. Carmel Elevator Co.	Mixed materials.
620	Joliet, Ill.	Chicago Gravel Co.	Chicago Gravel Co.	Mainly dirty limestone.
622	Terre Haute, Ind.	Summit Sand & Gravel Co.	Summit Sand & Gravel Co.	Mixed materials.
623	Chillicothe, Ill.	Mackinaw Sand & Gravel Co.	Mackinaw Sand & Gravel Co.	Mainly silica.
624	Chillicothe, Ill.	do.	do.	Mixed materials.
625	Chillicothe, Ill.	do.	do.	do.
626	Chillicothe, Ill.	do.	do.	do.
627	Honey Creek Pit.	Summit Sand & Gravel Co., Terre Haute, Ind.	Summit Sand & Gravel Co.	do.
633			J. H. Morher, Prophetstown.	do.
635	Mississippi River.	Mississippi Sand Co., Alton, Ill.	Mississippi Sand Co.	Mainly quartz.
642			J. E. Sankey, Springfield.	Mixed materials.
643	Kinsman, Ill.	J. P. Murphy, Kinsman	J. P. Murphy	Shaly limestone.
645	Lake Cicott, Ind.	Million Bros.	Million Bros.	Mixed materials.
646		Mackinaw Sand & Gravel Co., Peoria, Ill.	H. Nelch & Son, Springfield.	do.
647		do.	do.	do.
648		Joliet Sand & Gravel Co.	J. E. Sankey, Springfield.	Mainly limestone.
657	Havana, Ill.		J. E. Sankey, Springfield.	Mixed materials.
658	Lincoln, Ill.	Lincoln Sand & Gravel Co.	Lincoln Sand & Gravel Co.	do.
661	Lincoln, Ill.	do.	do.	do.
663		Mackinaw Sand & Gravel Co., Peoria, Ill.	Mackinaw Sand & Gravel Co.	do.
666	New Holand, Ill.		H. E. Surman.	do.
667	Pekin, Ill.	Virginia Timber Co., Springfield, Ill.	Virginia Timber Co.	do.
668	Moronts, Ill.	Lakin Bros.	Lakin Bros.	do.
669	Attica, Ind.	Kickapoo Sand & Gravel Co.	Kickapoo Sand & Gravel Co.	do.
671	Terre Haute, Ind.	Summit Sand & Gravel Co.	Summit Sand & Gravel Co.	do.
672	Terre Haute, Ind.	do.	do.	do.
675	Attica, Ind.	The Indiana Sand & Gravel Co.	The Indiana Sand & Gravel Co.	do.
677	Vincinnes, Ind.	Anderson & Theobolt Sand & Gravel Co.	Anderson & Theobolt Sand & Gravel Co.	do.
678	Rockford, Ill.	Rockford Sand & Gravel Co.	Rockford Sand & Gravel Co.	Mixed materials, a large per cent of quartz.
679	Rockford, Ill.	do.	do.	Mixed materials.
680	Attica, Ind.	The Indiana Sand & Gravel Co.	The Indiana Sand & Gravel Co.	do.
681	Pekin, Ill.	Virginia Timber Co.	Virginia Timber Co.	Mixed materials.
684	Covington, Ind.	Interstate Sand & Gravel Co.	Interstate Sand & Gravel Co.	Mixed materials, a large per cent of quartz.
685	Covington, Ind.	do.	do.	Mixed materials.
690		Mackinaw Sand & Gravel Co.	L. P. Scott, Springfield.	do.
692		do.	do.	Mixed materials, some soft pebbles.
695	Carrollton, Ill.		Irwing Wetzel, Carrollton.	do.

Continued.

Sieve analysis.												Clay and organic loam in sand, dry basis in per cent.	Tensile strength of mortar of 1 part cement and 3 parts sand in per cent of the tensile strength of mortar obtained with 1 part of the same cement and 3 parts of standard Ottawa sand.			Remarks.
Per cent passing 2½ inch sieve.	Per cent passing 2 inch sieve.	Per cent passing 1½ inch sieve.	Per cent passing 1¼ inch sieve.	Per cent passing 1 inch sieve.	Per cent passing ¾ inch sieve.	Per cent passing ½ inch sieve.	Per cent passing ⅜ inch sieve.	Per cent passing ¼ inch sieve.	Per cent passing ⅛ inch sieve.	Per cent passing 1-16 inch sieve.	Per cent passing 1-50 inch sieve.		Age, 7 days.	Age, 28 days.	Age, 90 days.	
.....	....	....	100	99	95	84	....	54	14	11	1	1.0	111	107	106	River gravel containing some shells.
.....	....	....	....	97	91	76	....	46	31	15	5	11.0	.....	.....	.....	
.....	....	....	....	95	86	70	....	31	13	6	....	4.0	.....	.....	.....	
.....	....	....	....	....	....	....	....	100	99	91	8.5	0.8	107	103	107	
.....	....	....	....	....	....	....	100	99	81	54	4	1.0	139	133	137	
.....	....	....	....	100	92	66	....	13	....	....	....	....	.....	.....	.....	
.....	....	100	....	55	5	....	....	....	....	....	....	....	.....	.....	.....	
.....	....	100	....	87	77	67	....	48	34	24	4	7.0	62	67	72	
.....	....	....	....	100	94	85	....	77	50	35	3	0.2	112	102	102	
.....	....	....	....	....	....	100	....	91	85	71	3	0.5	98	89	81	
.....	....	....	....	....	....	100	....	92	55	42	5	1.8	120	107	120	
.....	....	....	....	....	....	100	....	96	84	50	11	3.5	92	98	99	
.....	....	100	....	89	84	78	....	58	42	24	2	3.0	147	143	155	Bank run.
.....	....	....	....	....	....	....	100	96	78	44	9	5.0	102	111	114	
.....	....	100	....	83	66	37	....	2	....	....	....	....	.....	.....	.....	
.....	100	84	....	70	34	4	....	....	....	....	....	....	.....	.....	.....	Crushed gravel.
.....	....	100	....	80	55	23	....	2	....	....	....	....	.....	.....	.....	River gravel containing some shells.
.....	....	100	....	91	77	43	....	6	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	....	100	99	83	57	2	0.6	97	101	118	
.....	....	....	....	....	....	....	100	90	51	15	1	0.6	126	139	137	Washed sand.
.....	....	....	....	....	....	100	....	80	56	30	6.5	2.5	111	106	85	Creek gravel.
.....	....	....	....	....	....	....	....	100	96	60	3	0.6	103	101	106	
.....	....	....	....	....	....	....	....	100	85	65	8	2.5	107	105	99	
.....	....	....	....	....	....	....	100	95	79	56	5	1.0	103	101	112	Washedtorpedo sand.
.....	....	....	....	....	....	100	....	89	66	45	2	1.0	126	120	131	Grit sand.
.....	....	100	....	87	60	12	....	0	....	....	....	....	.....	.....	.....	
.....	....	....	100	94	40	4	....	0	....	....	....	....	.....	.....	.....	Screened and crushed gravel.
.....	....	100	....	99	93	82	....	54	33	27	3	0.8	123	126	120	
.....	....	....	....	....	....	....	100	96	93	81	7	1.0	89	81	89	
.....	....	100	....	46	32	13	....	0	....	....	....	....	.....	.....	.....	Partly crushed.
.....	....	....	....	....	....	....	100	93	71	39	4	1.0	150	153	159	Torpedo sand.
.....	....	100	....	92	89	75	58	38	19	13	1	2.0	158	159	155	
.....	....	....	....	....	....	....	....	100	79	22	11	1.5	127	145	142	
.....	....	....	100	87	75	58	....	33	24	13	5	1.7	.....	.....	.....	
.....	....	....	....	....	....	....	100	93	56	16	6	1.2	113	111	124	
.....	....	....	100	98	92	80	....	31	19	12	....	....	.....	.....	.....	
.....	100	90	....	60	46	40	....	28	21	15	7	8	.....	.....	.....	

TABLE XVII—

Laboratory number.	Pit.	Furnished by—	Submitted by—	Nature of material.
696	Spring Valley, Ill.	Western Sand & Gravel Co.	Western Sand & Gravel Co.	Mixed materials.
697	Spring Valley, Ill.	..do.	..do.	Mixed materials, a large per cent of granite.
698	Attica, Ind.	Kickapoo Sand & Gravel Co.	Kickapoo Sand & Gravel Co.	Mixed materials, somesoft pebbles.
704	Attica Ind.	Indiana Sand & Gravel Co.	Indiana Sand & Gravel Co.	Mixed materials.
705	South Beloit, Ill.	Beck Coal & Lumber Co., Harvey, Ill.	Illinois Hydraulic Stone & Construction Co.	..do.
707	Lincoln, Ill.	The Lincoln Sand & Gravel Co.	Lincoln Sand & Gravel Co.	..do.
708	Lincoln, Ill.	..do.	..do.	..do.
712	Plainfield, Ill.	Chicago Gravel Co.	Chicago Gravel Co.	Mainly limestone.
713	Plainfield, Ill.	..do.	..do.	..do.
714	Plainfield, Ill.	..do.	..do.	..do.
715	Plainfield, Ill.	..do.	..do.	..do.
716	Trevor, Wis.		H. G. Goelitz, Lake Villa, Ill.	Mixed materials.
717	Trevor, Wis.	..do.	..do.	Mainly limestone.
719	Joliet, Ill.	Joliet Sand & Gravel Co.	Nelch & Son, Springfield.	..do.
722	Algonquin, Ill.	Lake Shore Sand Co.	Lake Shore Sand Co.	Mixed materials, a large per cent of limestone.
723	Algonquin, Ill.	..do.	..do.	Mainly limestone.
726	Macksville, Ind.	Macksville Sand & Gravel Co.	Macksville Sand & Gravel Co.	Mixed silicious materials.
727	Beloit, Wis.	Atwood-Davis Sand & Gravel Co.	W. J. Walter, Glencoe, Ill.	Mixed materials, a large per cent of quartz.
728	Beloit, Wis.	..do.	..do.	Mixed materials.
730	Carrollton, Ill.		Irwing Wetzel, Carrollton.	Mainly fine silica.
731	Rockford, Ill.	Rockford Sand & Gravel Co.	Rockford Sand & Gravel Co.	Mixed materials, a large per cent of quartz.
733	Joliet, Ill.	Joliet Sand & Gravel Co.	Joliet Sand & Gravel Co.	Mainly limestone.
735	Sabula, Iowa.	The Sabula Sand & Gravel Co.	The Sabula Sand & Gravel Co.	Hard silicious materials.
736	Sabula, Iowa.	..do.	..do.	..do.
751	Mississippi Sand Co's. Pit, Alton, Ill.	Mississippi Sand Co., Alton, Ill.	R. F. Egan, Springfield	Mainly fine quartz.
752	Warrenville, Ill.	Esson Sand & Gravel Co.	Esson Sand & Gravel Co.	Mainly limestone.
753	Warrenville, Ill.	..do.	..do.	..do.
756	Vincennes, Ind.	Anderson & Theobolt Sand & Gravel Co.	E. D. Pedro, Petrolia.	Mixed materials.
760	Pekin, Ill.	Virginia Timber Co.	R. F. Egan, Springfield	..do.
763	Attica, Ind.	Indiana Sand & Gravel Co.	F. C. Feutz, Watseka.	Mixed materials, 1.5 per cent soft pebbles.
767	Attica, Ind.	..do.	R. L. Bell, Watseka.	Mixed materials, 3 per cent soft pebbles.
769	Janesville, Ill.	A. S. Rosing.	C. W. Jensen & Co., Chicago.	Mixed materials.
770	Janesville, Ill.	..do.	..do.	Mixed materials, a large per cent of limestone.
772		Mackinaw Sand & Gravel Co.	A. F. Keehner, Springfield.	Mixed materials.
773	Williamsport, Ind.	The Carmichael Gravel Co.	The Carmichael Gravel Co.	..do.
774	Williamsport, Ind.	..do.	..do.	..do.
775	Chester, Ill.	Yourtee-Roberts Sand Co.	Yourtee-Roberts Sand Co.	Mainly quartz.

Continued.

Sieve analysis.												Clay and organic loam in sand, dry basis in per cent.	Tensile strength of mortar of 1 part cement and 3 parts sand in per cent of the tensile strength of mortar obtained with 1 part of the same cement and 3 parts of standard Ottawa sand.			Remarks.
Per cent passing 2½ inch sieve.	Per cent passing 2 inch sieve.	Per cent passing 1½ inch sieve.	Per cent passing 1¼ inch sieve.	Per cent passing 1 inch sieve.	Per cent passing ¾ inch sieve.	Per cent passing ½ inch sieve.	Per cent passing ⅜ inch sieve.	Per cent passing ¼ inch sieve.	Per cent passing ⅛ inch sieve.	Per cent passing 1-16 inch sieve.	Per cent passing 1-50 inch sieve.		Age, 7 days.	Age, 28 days.	Age, 90 days.	
....	....	100	....	64	58	48	....	27	10	....	....	0.3	117	119	148	
.....	100	92	....	54	35	21	....	6	....	....	....	....	.....	.....	.....	
.....	....	100	....	91	71	34	....	5	....	....	....	....	.....	.....	.....	
.....	....	100	....	93	23	2	....	....	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	....	100	95	81	69	4	0.3	116	123	126	Torpedo sand.
.....	....	....	....	....	....	100	....	94	74	44	4	0.6	126	125	127	
.....	....	100	....	90	72	42	....	1	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	93	76	58	7	1.5	114	122	120	Torpedo sand.
.....	....	....	....	....	....	100	....	3	....	....	....	....	.....	.....	.....	Roofing gravel.
.....	....	....	100	81	32	2	....	....	....	....	....	....	.....	.....	.....	One inch gravel.
.....	....	100	....	98	70	48	....	30	25	19	2	....	.....	.....	.....	Concrete mixture.
.....	....	....	....	....	....	100	....	89	69	48	7	1.0	159	160	177	
.....	....	100	....	62	42	14	....	1	....	....	....	....	.....	.....	.....	
.....	....	100	....	93	75	38	....	6	1	....	....	....	.....	.....	.....	Partly crushed gravel.
.....	....	....	....	....	....	100	....	98	79	52	2	1.5	133	132	131	No. 2 torpedo sand.
.....	....	100	....	99	80	38	....	2	....	....	....	....	.....	.....	.....	No. 8 gravel.
.....	....	....	....	....	....	100	....	98	80	55	5	1.3	130	133	141	
.....	....	....	....	....	100	97	....	78	63	51	9	0.8	125	112	113	
.....	100	95	....	73	53	23	....	2	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	....	....	....	....	99	71	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	95	80	68	6	0.6	108	103	106	
.....	100	88	....	58	42	19	....	2	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	96	82	56	4	0.5	125	103	98	
.....	....	100	....	94	85	55	....	1	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	98	96	95	14	0	88	82	83	River sand.
.....	....	....	....	....	....	....	....	100	87	62	6	2.5	113	117	114	
.....	....	100	....	66	2	....	....	....	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	....	....	100	97	87	13	3.0	103	101	101	
.....	....	....	....	....	....	....	....	100	92	62	5	0.3	115	109	111	
.....	....	100	....	98	78	34	....	3	....	....	....	....	.....	.....	.....	
.....	....	100	....	98	70	9	....	1	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	93	83	71	9	0.2	113	107	101	Torpedo sand.
.....	....	100	....	82	54	19	....	....	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	94	71	43	9	1.5	139	134	136	
.....	....	....	....	....	....	100	....	95	65	36	4	0.3	148	146	146	Torpedo sand.
.....	....	100	....	77	43	16	....	1	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	....	....	100	98	76	7	0	120	102	105	River sand.

TABLE XVII—

Laboratory number.	Pit.	Furnished by—	Submitted by—	Nature of material
778	Petersburg, Ill.	Virginia Canning Co.	C. S. McArdle, Petersburg.	Mixed materials.
779	Plainfield, Ill.	Chicago Gravel Co.	Illinois Hydraulic Stone & Construction Co.	Mainly limestone.
780	Plainfield, Ill.	..do.	..do.	..do.
783			Beardstown Concrete Construction Co.	Mixed materials.
784			F. C Feutz, Watseka	Mixed materials, 1 per cent soft pebbles.
786	Chester, Ill.	Yourtee-Roberts Sand Co.	Yourtee-Roberts Sand Co.	Mainly quartz.
787	Mendota, Ill.	Conkey Sand & Gravel Co.	Conkey Sand & Gravel Co.	Mixed materials, a large per cent of limestone.
788	Mendota, Ill.	..do.	..do.	..do.
790		Sankey Sand & Gravel Co.	L. A. Doan, Pontiac	A large per cent of quartz, some organic matter.
791			..do.	Mixed materials.
794	Pekin, Ill.	Virginia Timber Co.	R. F. Egan, Springfield.	..do.
796	Moore Branch, Carlinville, Ill.		McBride & Wargensted, Carlinville, Ill.	Mixed materials, 3 per cent bog ore.
797	Moore Branch, Carlinville, Ill.		..do.	Mixed materials, 1.5 per cent bog ore.
798	Moore Branch, Carlinville, Ill.		..do.	Mixed materials, 2 per cent bog ore.
799	Mounts Branch, Carlinville.		..do.	Mixed materials, 6 per cent bog ore.
800	Carlinville, Ill.		..do.	Mixed materials.
801	Mt. Carmel, Ill.	Mt. Carmel Sand & Gravel Co.	Mt. Carmel Sand & Gravel Co.	Mixed materials, contains 6 per cent shells.
802	Mt. Carmel, Ill.	..do.	..do.	Mixed materials, 5 per cent shells.
803	Mt. Carmel, Ill.	..do.	..do.	Mixed materials.
804	Moronts, Ill.	H. D. Conkey Sand & Gravel Co.	H. D. Conkey Sand & Gravel Co., Mendota, Ill.	Mixed materials, 3 per cent soft pebbles.
805	Moronts, Ill.	..do.	..do.	Mixed materials, a large per cent of quartz.
806		Interstate Sand & Gravel Co.	J. W. Stipes, Champaign, Ill.	Mixed materials.
807		..do.	..do.	Mixed materials, 8 per cent soft stone.
808	Kankakee, Ill.		F. M. Enos, C. S. H., Kankakee, Ill.	Shaly limestone.
809	Kankakee, Ill.		..do.	Shaly limestone, 20 per cent soft limestone.
810	Kankakee, Ill.		..do.	Shaly limestone.
812	Terre Haute, Ind.	Wabash Sand & Gravel Co.	Wabash Sand & Gravel Co.	Mixed materials.
813	Pekin, Ill.	Virginia Timber Co.	R. F. Egan, Springfield	..do.
814	Terre Haute, Ind.	Summit Sand & Gravel Co.	Summit Sand & Gravel Co.	..do.
816		Consumers Co., Chicago	Consumers Co., Chicago	..do.
821	Warrenville, Ill.	Esson Sand & Gravel Co.	Esson Sand & Gravel Co.	..do.
824	Kankakee, Ill.	C. V. Ruhle	C. V. Ruhle, Springfield	..do.
832	Vincennes, Ind.	Anderson & Theobolt Sand & Gravel Co.	F. S. Nichols, Flora, Ill.	Mainly silicious materials.
833	Vincennes, Ind.	..do.	..do.	..do.
836	Merom, Ind.	Merom Gravel Co.	Merom Gravel Co.	Mixed materials.
837	Merom, Ind.	..do.	..do.	Mixed silicious materials.

Continued.

Sieve analysis.												Clay and organic loam in sand, dry basis in per cent.	Tensile strength of mortar of 1 part cement and 3 parts sand in per cent of the tensile strength of mortar obtained with 1 part of the same cement and 3 parts of standard Ottawa sand			Remarks.
Per cent passing 2½ inch sieve.	Per cent passing 2 inch sieve.	Per cent passing 1½ inch sieve.	Per cent passing 1¼ inch sieve.	Per cent passing 1 inch sieve.	Per cent passing ¾ inch sieve.	Per cent passing ½ inch sieve.	Per cent passing ⅜ inch sieve.	Per cent passing ¼ inch sieve.	Per cent passing 8 inch sieve.	Per cent passing 1-16 inch sieve.	Per cent passing 1-50 inch sieve.		Age, 7 days.	Age, 28 days.	Age, 90 days.	
.....	....	....	....	....	....	100	....	97	91	75	6	2.2	101	86	91	Contains 1 per cent organic matter.
.....	....	100	....	69	39	10	....	1	....	....	....	....	.....	.....	.....	No. 8 washed gravel.
.....	....	....	....	....	....	100	....	96	84	70	7	0.6	137	137	143	Torpedo sand.
.....	....	....	....	....	100	96	....	73	43	22	3	2.0	140	112	118	
.....	....	100	....	90	58	8	....	1	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	100	98	....	95	83	58	5	0	123	116	117	River sand.
.....	....	....	....	....	....	100	....	95	84	69	7	0.5	130	112	114	
.....	....	100	....	66	31	8	....	1	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	97	93	84	10	1.0	109	100	103	
.....	....	....	....	....	....	....	....	....	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	75	55	39	1	0.3	139	132	128	
.....	....	....	....	....	....	100	....	94	78	60	7	2.1	119	100	96	Creek sand No. 1.
.....	....	....	....	....	....	....	....	100	90	67	9	1.0	116	102	99	Creek sand No. 2.
.....	....	....	....	....	....	100	....	99	86	72	16.5	1.2	107	106	102	Creek sand No. 3.
.....	....	....	....	....	....	100	....	92	62	44	9	2.0	105	101	108	Creek sand No. 4.
.....	....	100	....	93	79	53	....	3	....	....	....	....	.....	.....	.....	Creek gravel No. 5.
.....	....	100	....	96	92	76	....	50	30	15	1	0.3	138	119	122	Bar run gravel.
.....	....	100	....	90	82	65	....	23	2	....	....	....	.....	.....	.....	Screened river gravel.
.....	....	....	....	....	....	100	....	99	98	82	5	0.5	116	106	108	River sand.
.....	....	100	....	90	81	54	....	3	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	98	93	86	28	1.0	112	103	107	
.....	....	....	....	....	....	100	....	97	76	38	2.5	1.0	157	135	141	
.....	....	100	....	63	36	9	....	1	....	....	....	....	.....	.....	.....	
.....	....	....	....	100	98	94	....	80	52	16	3.5	3.0	151	132	138	
.....	....	100	....	70	43	16	....	4	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	100	....	99	95	78	9	7.0	113	118	123	
.....	....	....	....	....	....	....	....	100	86	65	8	0.3	146	133	132	
.....	....	....	....	....	....	100	....	90	84	70	8	0.6	147	133	133	
.....	....	....	....	....	....	....	100	97	78	55	3	0.5	143	135	133	
.....	....	....	....	....	....	....	100	92	71	51	8	0.6	146	144	160	
.....	....	100	....	65	45	16	....	1	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	....	100	98	77	55	10	1.1	131	126	130	Washed torpedo sand.
.....	....	....	....	....	....	100	95	90	59	29	3	0.5	155	149	155	
.....	100	98	....	89	83	65	....	32	8	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	....	100	99	95	75	4	0.15	132	125	132	
.....	....	100	....	85	73	50	....	23	12	5	....	....	.....	.....	.....	

TABLE XVII—

Laboratory number.	Pit.	Furnished by—	Submitted by—	Nature of material.
842	Waukesha, Wis.	Waukesha Lime & Stone Co.	H. G. Goelitz, Oak Park	Mixed materials, mainly limestone.
843	Waukesha, Wis.	..do	..do	Mixed materials.
846	Terre Haute, Ind.	Summit Sand & Gravel Co.	Goggin Construction Co. Arcola, Ill.	..do
847	Terre Haute, Ind.	..do	..do	..do
848	Terre Haute, Ind.	..do	..do	..do
849	Terre Haute, Ind.	..do	..do	..do
850	Terre Haute, Ind.	..do	..do	..do
853	Rockdale, Ill.	Chicago Gravel Co.	F. Tarrant, Beardstown	..do
854	Lincoln, Ill.	Lincoln Sand & Gravel Co.	Lincoln Sand & Gravel Co.	..do
856	Vincennes, Ind.		M. M. Small, Bridgeport	..do
857		Illinois Sand & Gravel Co.	C. S. McArdle, Petersburg.	..do
858		Chicago Gravel Co.	..do	Mainly limestone.
862		Indiana Sand & Gravel Co.	F. C. Feutz, Watseka.	Mixed Materials.
866	Grape Creek, Ill.	J. W. Lanham, Danville, Ill.	J. W. Lanham, Danville, Ill.	..do
867	Grape Creek, Ill.	..do	..do	Mixed materials, 3 per cent soft pebbles.
872		Mackinaw Sand & Gravel Co.	J. H. Baker, Lincoln	Mixed materials.
873		..do	..do	Mixed materials, 7 per cent soft pebbles.
877	Elgin, Ill.	A. Y. Reed Gravel Co.	A. Y. Reed Gravel Co.	Mixed materials, a large per cent of limestone.
878	Elgin, Ill.	..do	..do	..do
879	Elgin, Ill.	..do	..do	Mixed materials.
880			M. C. Hall, Eureka, Ill.	..do
884		American Sand & Gravel Co., Chicago.	American Sand & Gravel Co., Chicago, Ill.	..do
885		Chicago Sand & Gravel Co.	H. B. Bushnell, Harvey	Mainly limestone.
886		..do	..do	..do
887			E. J. Mahoney & Co.	..do
888			..do	Mixed materials.
889	Chester, Ill.	Yourtee Roberts Sand Co.	Yourtee Roberts Sand Co.	Mainly quartz.
892	Quincy, Ill.		Cameron, Joyce & Co.	..do
901		Wabash Sand & Gravel Co.	R. W. Hommes, Danville.	Mixed materials.
902	Danville, Ill.		..do	Mixed materials, 2½ per cent soft grains.
903		..do	..do	Mixed materials.
904	Danville, Ill.		..do	Mixed materials, 3 per cent soft pebbles.
907	Mt. Pulaski, Ill.	J. E. Sankey, Springfield.	J. E. Sankey, Springfield.	Mixed materials.
911	Greenville, Ill.	R. Curdie, Greenville.	R. Curdie, Greenville.	Mainly quartz.
912	Greenville, Ill.	..do	..do	Mixed materials.
915	Danville, Ill.	C. B. Hooton, Danville	C. B. Hooton, Danville	Mixed materials, 10 per cent soft.
916		Continental Portland Cement Co., St. Louis, Mo.	Continental Portland Cement Co., St. Louis, Mo.	Mainly chert.
918		Union Sand & Material Co., St. Louis, Mo.	Union Sand & Material Co., St. Louis, Mo.	Silicious materials.
919	Rockdale, Ill.	Joliet Sand & Gravel Co.	J. E. Sankey, Springfield.	Mainly limestone.

Continued.

Sieve analysis.												Clay and organic loam in sand, dry basis in per cent.	Tensile strength of mortar of 1 part cement and 3 parts sand in per cent of the tensile strength of mortar obtained with 1 part of the same cement and 3 parts of standard Ottawa sand.			Remarks.
Per cent passing 2½ inch sieve.	Per cent passing 2 inch sieve.	Per cent passing 1½ inch sieve.	Per cent passing 1¼ inch sieve.	Per cent passing 1 inch sieve.	Per cent passing ¾ inch sieve.	Per cent passing ½ inch sieve.	Per cent passing ⅜ inch sieve.	Per cent passing ¼ inch sieve.	Per cent passing ⅛ inch sieve.	Per cent passing 1-16 inch sieve.	Per cent passing 1-50 inch sieve.		Age, 7 days.	Age, 28 days.	Age, 90 days.	
.....	.....	.....	.....	.....	.....	.....	100	97	69	36	2	0.3	144	146	158	
.....	.....	100	.....	60	31	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	
.....	.....	100	.....	98	94	87	.....	74	30	8	1	0.8	.....	.....	.....	
.....	.....	100	.....	98	96	80	.....	68	42	20	3	1.0	.....	.....	.....	
.....	.....	100	.....	99	97	95	.....	76	56	32	3	1.2	128	136	134	
.....	100	95	.....	87	82	78	.....	56	26	12	2	1.2	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	100	97	67	35	4	1.2	136	137	137	Grit sand.
.....	.....	100	.....	95	78	33	.....	3	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	.....	100	95	75	11	0.6	116	111	119	
.....	.....	100	.....	93	89	80	.....	52	26	10	2	0.6	143	138	137	
.....	.....	.....	.....	.....	100	98	.....	77	50	40	3	0.5	120	121	125	
.....	.....	100	.....	83	45	9	.....	1	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	100	.....	92	73	45	6	2.0	136	133	138	
.....	.....	.....	.....	.....	.....	100	.....	99	98	95	6	4.0	137	122	124	
.....	.....	100	.....	84	72	45	.....	13	7	6	1	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	100	.....	96	72	40	8	1.0	131	141	150	
.....	.....	100	.....	99	94	81	.....	43	32	19	5	1.7	137	152	157	
.....	.....	.....	.....	.....	.....	100	.....	90	62	30	2	0.3	137	152	162	No. 2 sand.
.....	.....	100	.....	75	48	21	.....	4	.....	.....	.....	.....	.....	.....	.....	No. 8 gravel.
.....	100	96	.....	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	No. 9 gravel.
.....	.....	.....	.....	.....	.....	100	.....	96	67	42	5	0.6	154	148	150	
.....	.....	.....	.....	.....	.....	.....	100	97	87	67	10	1.7	120	125	140	
.....	.....	.....	.....	.....	.....	100	.....	88	58	36	5	1.7	143	147	162	
.....	.....	100	.....	95	83	58	.....	10	.....	.....	.....	.....	.....	.....	.....	
.....	.....	100	.....	53	29	11	.....	0	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	100	95	76	57	9	1.3	110	123	141	
.....	.....	.....	.....	.....	100	98	.....	96	90	70	10	0	106	105	112	River sand.
.....	.....	.....	.....	.....	.....	100	.....	98	95	84	6	0	86	89	93	River sand.
.....	.....	.....	.....	.....	.....	.....	.....	100	97	80	11	0.6	110	119	127	
.....	.....	.....	.....	100	.....	95	.....	92	83	58	6	2.5	134	126	141	
.....	.....	100	96	90	77	58	.....	27	10	3	.....	.....	.....	.....	.....	
.....	.....	100	.....	68	63	50	.....	28	16	12	4	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	100	.....	92	60	37	7	1.0	118	120	121	
.....	.....	.....	.....	.....	.....	.....	100	98	96	84	5	1.0	115	112	119	
.....	.....	.....	.....	100	100	96	.....	94	84	67	14	0.8	133	121	124	
.....	.....	.....	.....	.....	.....	100	.....	93	85	67	17	5.3	106	.....	.....	
.....	.....	.....	.....	.....	.....	100	.....	56	10	3	.....	.....	128	109	112	Torpedo sand.
.....	.....	.....	.....	.....	.....	.....	.....	100	95	89	34	0.3	116	106	.....	
.....	.....	.....	.....	.....	.....	100	.....	87	51	22	3	1.7	134	135	143	

TABLE XVII—

Laboratory number.	Pit.	Furnished by—	Submitted by—	Nature of material.
920	Beloit, Wis		F. Taylor, Belvidere, Ill.	Mixed materials
921	Beloit, Wis		do	do
929	Alton, Ill	Mississippi Sand Co	Mississippi Sand Co	Mainly quartz
934	Quincy, Ill		Cameron, Joyce & Co	do
936	Beloit, Wis	Atwood-Davis Sand Co.	C. W. Jensen & Co., Chicago, Ill.	Mixed materials
937	Beloit, Wis	do	do	do
939	Cairo, Ill	H. H. Halliday Sand Co.	H. H. Halliday Sand Co.	Mainly quartz
941	Lincoln, Ill	Lincoln Sand & Gravel Co.	W. A. Davenport, Delavan, Ill.	Mixed materials
942	Lincoln, Ill	do	do	do
943	Lincoln, Ill	do	do	do
944		Mackinaw Sand & Gravel Co.	F. Tarrant, Springfield	do
948	Beloit, Wis		Logan & Giertz Construction Co.	do
949	Beloit, Wis		do	do
950	Pekin, Ill	Virginia Timber Co	T. Plack, Jerseyville	do
958	Lincoln, Ill	Lincoln Sand & Gravel Co.	W. W. Shanor, Springfield.	do
964	Lincoln, Ill	do	F. Tarrant, Beardstown	do
965	Lincoln, Ill	do	do	do
971		Illinois Sand & Gravel Co.	C. S. McArdle, Petersburg.	do
973	Williamsport, Ind	The Carmichael Gravel Co.	R. F. Egan, Springfield	do
977			McCarthy Improvement Co., Davenport, Iowa.	Silicious materials
978			do	do
980	Vandalia, Ill		P. M. Johnston, St. Elmo, Ill.	Mixed materials
982		Joliet Sand & Gravel Co.	F. Tarrant, Beardstown	Mixed materials, mainly limestone.
984	Lincoln, Ill	Lincoln Sand & Gravel Co.	F. Tarrant, Beardstown	Mixed materials
988	Cairo, Ill		B. LaRue, Whittington	Mainly silicious materials.
989	Cairo, Ill		do	do
993	Morisson, Ill		Shugart & Munsen, Morisson, Ill.	Mixed materials
1010	Beloit, Wis	Beloit Sand & Gravel Co.	Beloit Sand & Gravel Co.	do
1011	Beloit, Wis	do	do	do
1012	Beloit, Wis	do	do	do
1014	La Grange, Mo		Cameron, Joyce & Co., Quincy, Ill.	Mainly silicious materials.
1015	Lincoln, Ill	Lincoln Sand & Gravel Co.	F. Tarrant, Springfield	Mixed materials
1016	Lincoln, Ill	do	do	do
1018	Metropolis, Ill	Willis & Co	Willis & Co., Metropolis, Ill.	Silicious materials
1025	Attica, Ind	Attica Gravel Co	C. C. Hinsdale, Sullivan	Mainly silicious materials
1026			McCarthy Improvement Co., Davenport, Iowa.	Mixed materials
1029	Vandalia, Ill		P. M. Johnston & Co., St. Elmo.	do
1031	La Grange, Mo		Cameron, Joyce & Co., Quincy, Ill.	Mainly silicious materials
1032	La Grange, Mo		do	do

Continued.

Sieve analysis.													Clay and organic loam in sand, dry basis in per cent.	Tensile strength of mortar of 1 part cement and 3 parts sand in per cent of the tensile strength of mortar obtained with 1 part of the same cement and 3 parts of standard Ottawa sand.			Remarks.
Per cent passing 2½ inch sieve.	Per cent passing 2 inch sieve.	Per cent passing 1½ inch sieve.	Per cent passing 1¼ inch sieve.	Per cent passing 1 inch sieve.	Per cent passing ¾ inch sieve.	Per cent passing ½ inch sieve	Per cent passing ⅜ inch sieve.	Per cent passing ¼ inch sieve.	Per cent passing ⅛ inch sieve.	Per cent passing 1-16 inch sieve.	Per cent passing 1-50 inch sieve.		Age, 7 days.	Age, 28 days.	Age, 90 days.	
.....	.....	.....	.....	.....	.....	.....	100	93	80	69	7	0.2	122	120	121	
.....	.....	.....	100	93	65	34	.....	2	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	100	98	93	75	6	0	110	112	108	River sand.
.....	.....	.....	.....	.....	.....	.....	.....	100	99	89	2	0.2	99	93	98	River sand.
.....	.....	.....	100	85	65	34	.....	1	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	100	96	84	68	7	0.2	113	123	128	
.....	.....	.....	.....	.....	.....	.....	.....	100	97	83	7	0.15	108	108	109	River sand.
.....	.....	.....	.....	.....	.....	.....	100	99	95	82	11	0.3	112	105	118	
.....	.....	.....	.....	.....	.....	.....	100	99	92	80	10	0.5	113	109	117	
.....	.....	.....	.....	.....	.....	.....	100	96	87	67	7	0.3	117	119	146	
.....	.....	.....	.....	.....	.....	.....	100	91	60	31	3	1.7	128	134	139	
.....	.....	.....	.....	.....	.....	.....	100	96	85	72	7	0.5	109	109	113	
.....	.....	100	.....	85	36	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	100	96	94	79	57	4	0.7	133	138	145	
.....	.....	.....	.....	.....	.....	.....	100	96	93	75	9	1.0	113	114	127	
.....	.....	.....	.....	.....	.....	.....	100	96	88	68	3	0.6	133	124	136	
.....	.....	.....	.....	.....	.....	.....	100	96	81	61	3	0.2	112	120	133	
.....	.....	.....	.....	.....	.....	.....	100	96	94	85	10	4.0	101	100	99	
.....	.....	.....	.....	100	92	58	.....	18	7	2	1	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	100	.....	98	93	63	8	0.6	100	120	117	
.....	100	98	94	75	37	16	.....	2	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	100	.....	97	.....	90	81	61	8	1.3	148	148	144	
.....	100	95	94	85	67	43	.....	11	2	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	100	99	90	75	11	1.0	114	110	127	
.....	.....	.....	.....	.....	.....	.....	.....	100	91	75	10	0.2	116	117	117	River sand.
.....	.....	.....	.....	.....	.....	.....	.....	100	92	82	10	0.3	111	105	98	River sand.
.....	.....	.....	.....	.....	.....	100	.....	96	90	75	5	1.0	106	108	101	
.....	100	58	38	14	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	100	99	56	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	100	93	57	.....	1	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	100	96	86	55	.....	4	.....	.....	.....	.....	.....	.....	.....	River gravel.
.....	.....	.....	.....	.....	.....	.....	100	97	90	79	6	0.2	113	121	.....	
.....	.....	.....	.....	.....	.....	.....	100	98	93	80	8	0.2	112	113	.....	
.....	.....	.....	.....	.....	.....	.....	.....	100	98	91	7	0.2	105	92	.....	River sand.
.....	100	99	.....	88	80	57	.....	3	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	99	.....	95	91	70	6	0.8	110	108	.....	River sand.
.....	.....	.....	.....	.....	.....	100	.....	95	87	76	5	1.7	90	93	.....	
.....	.....	.....	.....	.....	.....	100	.....	96	66	57	10	0.5	90	102	.....	River sand.
.....	.....	100	97	95	74	34	.....	1	.....	.....	.....	.....	.....	.....	.....	

TABLE XVII—

Laboratory number.	Pit.	Furnished by—	Submitted by—	Nature of material.
1036	Spring Valley, Ill.		H. S. Wetherell, La Salle.	Mixed materials.
1042	Spring Valley, Ill.		do	do.
1047	Gladstone, Ill.	Terry & Lewis, Galesburg, Ill.	Merrifield Construction Co., Monmouth, Ill.	Silicious materials.
1050			C. A. Penington, Taylorville, Ill.	Mixed materials.
1055			do	do.
1072	Danville, Ill.		P. F. Jervis, Danville, Ill.	Silicious materials.
1073	Vincennes, Ind.		C. A. Penington, Taylorville, Ill.	Mixed materials.
1077	Spring Valley, Ill.		C. A. Clark, LaSalle, Ill.	do.
1082	Spring Valley, Ill.		do	do.
1093	Oregon, Ill.		Gund-Graham Co., Oregon.	do.
1100	Taylor Ridge, Ill.		C. Dunlap, Taylor Ridge.	Very fine quartz.
1101			O. B. Kercher, Argo, Ill.	Mixed materials.
1103	La Grange, Mo.		Cameron, Joyce & Co., Quincy, Ill.	Mainly silicious materials
1104	La Grange, Mo.		do	do.
990		P. Flannery & Son, East St. Louis, Ill.	P. M. Johnston & Son, St. Elmo, Ill.	A large per cent of limestone.

TABLE XX—TESTS OF

Laboratory number.	Pit.	Nature of material.	Submitted by—
545	Near Spoon River Bridge, west of Wyoming, Ill.	Too fine and clean for bonding gravel.	W. M. Slater, Wyoming, Ill.
546	Near Spoon River Bridge, west of Wyoming, Ill.	Too fine for bonding gravel.	do.
627	Honey Creek Pit.	Mixed materials.	Summit Sand & Gravel Co., Terre Haute, Ind.
835	Hills northwest of Cairo, Ill.	Mixed materials containing red clay.	B. H. Piepmeier, Springfield, Ill.

TABLE X-X -Title-

| | | |

Concluded.

Sieve analysis.												Clay and organic loam in sand, dry basis in per cent.	Tensile strength of mortar of 1 part cement and 3 parts sand in per cent of the tensile strength of mortar obtained with 1 part of the same cement and 3 parts of standard Ottawa sand.			Remarks.
Per cent passing 2½ inch sieve.	Per cent passing 2 inch sieve.	Per cent passing 1½ inch sieve.	Per cent passing 1¼ inch sieve.	Per cent passing 1 inch sieve.	Per cent passing ¾ inch sieve.	Per cent passing ½ inch sieve.	Per cent passing ⅜ inch sieve.	Per cent passing ¼ inch sieve.	Per cent passing 8 inch sieve.	Per cent passing 1-16 inch sieve.	Per cent passing 1-50 inch sieve.		Age, 7 days.	Age, 28 days.	Age, 90 days.	
.....	....	....	....	100	94	88	....	60	41	20	2	5.0	155	152	.....	
.....	....	....	....	100	99	90	....	62	40	21	3	2.7	145	137	.....	
.....	....	....	....	100	99	98	....	94	93	87	8	0.6	89	82	.....	
.....	....	....	....	100	99	96	....	74	49	31	3	2.0	133	138	.....	
.....	....	....	....	100	99	94	....	69	50	32	5	1.5	150	136	.....	
.....	....	....	....	100	99	98	....	95	91	78	13	5.0	80	77	.....	
.....	....	100	....	97	90	75	....	49	27	15	2	1.6	142	131	.....	
.....	....	....	....	100	93	50	....	12	....	....	....	....	.....	.....	.....	
.....	....	....	....	100	97	75	....	34	12	5	2	....	.....	.....	.....	
.....	100	85	70	51	27	1	....	....	....	....	....	....	.....	.....	.....	
.....	....	....	....	....	....	....	....	....	....	100	67	....	85	92	.....	
.....	....	....	....	....	100	99	....	94	83	62	11	6.5	.....	.....	.....	Grouting sand.
.....	....	100	98	93	76	37	....	2	....	....	....	....	.....	.....	.....	River gravel.
.....	....	100	98	93	83	65	....	45	32	27	4	5.0	100	.....	.....	River gravel.
.....	....	....	....	....	....	100	....	88	49	17	3	0.7	148	149	155	Mine chats.

ROAD GRAVELS—1914.

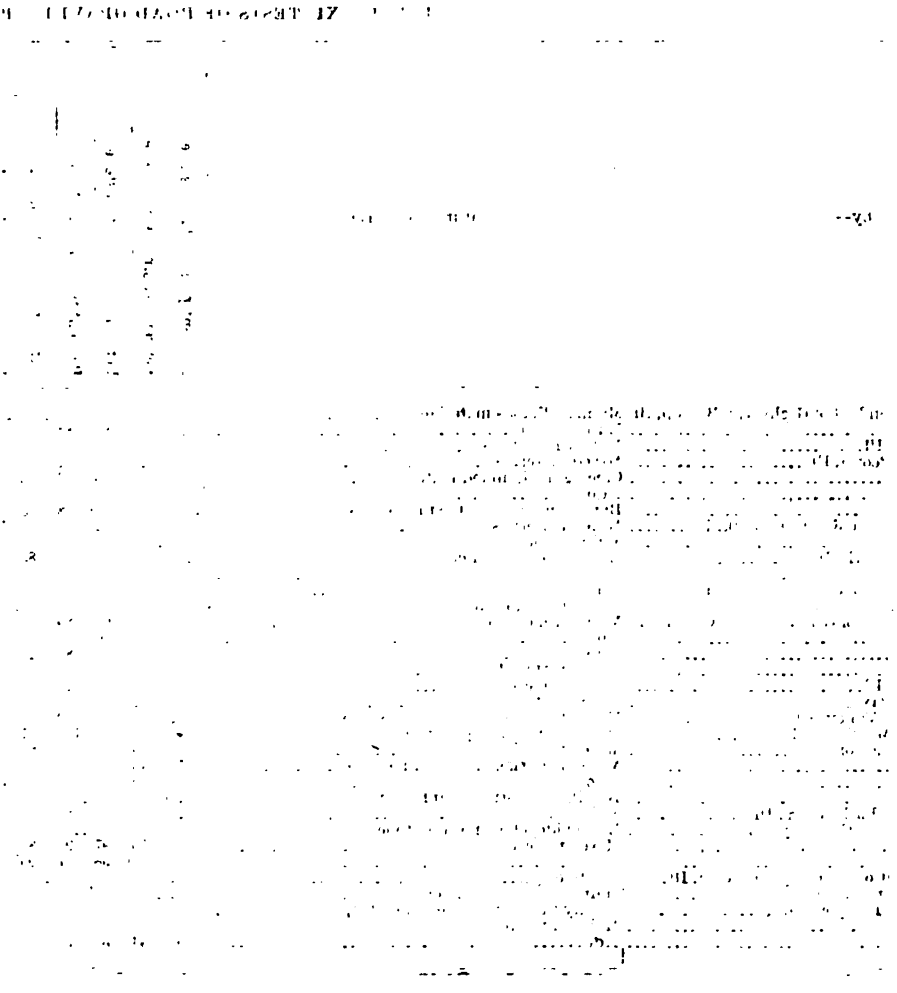
Sieve analysis.											Per cent clay in gravel, dry basis.	Iron derivatives obtained from clay by leaching with dilute acid, reported as iron oxide in per cent of clay.	Iron oxide calculated in per cent of gravel	Remarks.
Per cent passing 2½ inch sieve.	Per cent passing 2 inch sieve.	Per cent passing 1½ inch sieve.	Per cent passing 1¼ inch sieve.	Per cent passing 1 inch sieve.	Per cent passing ¾ inch sieve.	Per cent passing ½ inch sieve.	Per cent passing ⅜ inch sieve.	Per cent passing ¼ inch sieve.	Per cent passing 1-16 inch sieve.	Per cent passing 1-50 inch sieve.				
.....	....	....	....	....	100	....	74	57	.....	.....	1.0	.....	.....	Proposed for use with 546.
.....	....	100	....	....	....	....	77	....	.....	.....	15	.....	.....	Proposed for use with 545.
.....	....	100	....	87	77	67	48	34	24	4	7	.....	.....	
.....	....	100	96	91	73	61	48	42	40	.....	20	10.1	2.02	Gravel shows good binding qualities.

TABLE XX—

Laboratory number.	Pit.	Nature of material.	Submitted by—
1065	Elco No. 3, Elco Pit near Tamms, Ill.	Crushed novaculite with red clay.	M. W. Watson, Mounds, Ill.
1066	Wagner Pit, ¾ mile east of Station O, Route 1, Alexander County.	Mixed materials containing clay.	..do.....
1068	Pekin, Ill.....	Rather fine, clean and hard..	H. V. Schoonover, Havana, Ill.
1074	Whitiker Hill Pit, 1 mile west of Hodges Park Station, Route 1, Alexander County.	Mainly chert with yellow clay	M. W. Watson, Hodges Park, Ill.
1075	On property of Fred Hood, 1 mile east of Station 60, Route 1, Alexander County.	Mixed materials containing red clay.	..do.....
1076	Droges Gravel Pit, 2½ miles south of Station O, Route 1, Alexander County.	..do.....	..do.....
1084	Pit 2 miles west of Station O, Route 1 Union County.	Mixed materials containing brown clay.	M. W. Watson, Anna, Ill.....
1083	Pit 3½ miles southwest of Station O, Route 1, Union County.	..do.....	..do.....
1094	Pekin, Ill.....	Mixed materials, fally hard...	H. V. Schoonover, Havana, Ill.

TABLE XXII—

Laboratory number.	Trade name.	Furnished by—	Submitted by—	Per cent of Pigment by weight.	Per cent of vehicle by weight.
412	Boiled linseed oil.....	J. E. Meffley & Son, Galena, Ill.	J. E. Meffley & Son, Galena, Ill.	.....	.....
413	Sublimed Blue Lead Paste..	.....	..do.....	.....	.....
421	Sublimed White Lead Paint	.....	A. M. Helffrich, Ottawa, Ill.	72.7	27.3
429	Boiled Linseed Oil.....	.....	..do.....	.....	.....



Laboratory number.	
1065	Elco I
1066	Wagn Rou
1068	Pekin
1074	Whiti Hoo Ale.
1075	On pr of S Cou
1076	Drogu Sta Cou
1084	Pit 2 Un
1083	Pit 3 Ro
1094	Peki

Laboratory number.	
412	Boll
413	Subl
421	Sub
429	Boll

Concluded.

Sieve analysis.													Remarks.
Per cent passing 2½ inch sieve.	Per cent passing 2 inch sieve.	Per cent passing 1½ inch sieve.	Per cent passing 1¼ inch sieve.	Per cent passing 1 inch sieve.	Per cent passing ¾ inch sieve.	Per cent passing ½ inch sieve.	Per cent passing ¼ inch sieve.	Per cent passing ⅛ inch sieve.	Per cent passing 1-16 inch sieve.	Per cent passing 1-50 inch sieve.	Per cent clay in gravel, dry basis.	Iron derivatives obtained from clay by leaching with dilute acid, reported as iron oxide in per cent of clay.	Iron oxide calculated in per cent of gravel.	
.....	....	....	....	....	100	92	40	12	9	5	26	2.42	0.63	Binds well, but material crushed to coarser size should be used.
.....	....	....	100	98	94	88	81	77	74	49	51	8.7	4.44	This gravel shows good binding qualities.
.....	100	98	....	97	94	79	54	38	22	3	3	.....	.....	
.....	100	....	....	83	70	47	22	14	9	6	8.4	1.85	0.16	
.....	100	98	....	62	52	41	29	25	17	6	12	8.7	1.04	Gravel shows good binding qualities.
100	93	88	....	55	41	37	30	26	20	5	4.3	14.25	0.61	Gravel shows good binding qualities.
.....	100	88	....	63	47	35	18	9	5	3	1.0	2.75	0.03	
.....	100	99	....	76	56	35	15	7	5	2	3	.....	.....	
.....	....	100	....	99	95	90	66	48	31	5	4.8	.....	.....	

TESTS OF PAINTS—1913.

Analysis of pigment.							Tests on linseed oil.					Remarks.
Lead sulphate in per cent.	Lead sulphite in per cent.	Lead sulphide in per cent.	Lead oxide in per cent.	Zinc oxide in per cent.	Iron and aluminum oxides in per cent.	Carbon and volatile matter in per cent.	Specific gravity at 15.5°C.	Acid figure.	Saponification value.	Flash point in open cup in °C.	Foots in per cent.	
.....	.....	.....	.....	.....	.....	.....	0.941	6.8	197	298	Trace	
36.8	7.0	PbO & PbS calculated as 3PbO, 1PbS 33.4.		1.6	.....	.....	.....	.....	.....	.....	.....	Paste received spilled in package, the pigment contains about 20 per cent of impurities from packing.
68.8	.....	.....	22.5	5.2	.....	.....	.....	.....	.....	.....	.....	Vehicle shows no volatile oils by steam distillation.
.....	.....	.....	.....	.....	.....	.....	0.937	8.6	191	110	.....	Not pure linseed oil. Contains about 5 per cent turpentine.

TABLE XXII—

Laboratory number.	Trade name.	Furnished by—	Submitted by—	Per cent of pigment by weight.	Per cent of vehicle by weight.
440	Gray Bridge Paint, Shade 57 S. O. 2734.	Detroit Graphite Co., Detroit, Mich.	A. M. Heiffrich, Ottawa, Ill.	53.0	47.0
442	Sublimed Blue Lead Paint..	Picher Lead Co., Joplin, Mo.	..do.....	55.0	45.0
445	White Bridge Paint.....	Acme White Lead Works, Detroit, Mich.	..do.....	64.2	35.8
480	Sublimed Blue Lead Paint..	Picher Lead Co., Joplin, Mo.	..do.....	62.0	38.0
498	Sublimed Blue Lead Paint..	Becker-Moore Paint Co., St. Louis, Mo..	Miller & Borchering, Contractors, St. Louis. Mo.	53.3	46.7

TABLE XXIII—

Laboratory number.	Trade name.	Furnished by—	Submitted by—	Specific gravity at 25 °C.	Pounds per gallon.
604	Basic Lead Sulphate in Oil.	Heath & Milligan Mfg. Co., Chicago.	Modern Steel Structural Co., Waukesha, Wis.	.....	.....
631	Sublimed White Lead Paint	John Lucas & Co., Chicago.	.....	.....	.....
632	Sublimed Blue Lead Paint..	..do.....	.....	.....	.....
636	Sublimed Blue Lead Paint..	Heath & Milligan Mfg. Co., Chicago.	C. R. A. Marshall, Strong-hurst, Ill.	.....	.....
637	Sublimed Blue Lead Paint..	John H. Witte, Burlington, Iowa.	..do.....	.....	.....
650	Sublimed Blue Lead Pigment.	National Lead Co., Chicago	Continental Bridge Co.....	.....	.....
651	Boiled Linseed Oil.....	..do.....	..do.....	.....	.....
737	Sublimed Blue Lead Paint..	John H. Witte, Burlington, Iowa.	C. R. A. Marshall, Strong-hurst, Ill.	1.78	14.8
738	Sublimed Blue Lead Paint..	Heath & Milligan Mfg. Co., Chicago.	..do.....	1.92	16.0
1092	Basic Lead Sulphate in Oil.	..do.....	Modern Steel Structural Co., Waukesha, Wis.	.....	.....

Concluded.

Analysis of pigment.							Tests on linseed oil.					Remarks.
Lead sulphate in per cent.	Lead sulphite in per cent.	Lead sulphide in per cent.	Lead oxide in per cent.	Zinc oxide in per cent.	Iron and aluminum oxides in per cent.	Carbon and volatile matter in per cent.	Specific gravity at 15.5°C.	Acid figure.	Saponification value.	Flash point in open cup in °C.	Foots in per cent.	
46.0	Trace	PbO & PbS calculated as PbO 38.8.		Trace	2.1	.....	.....	.....	.....	.....	.....	Contains 10.8 per cent of graphite.
39.3	4.0	PbO & PbS calculated as 3PbO, 1PbS 43.4.		1.4	1.4	2.8	.....	.....	.....	.....	.....	
79.5	.....	.....	13.5	4.7	.....	.....	.....	.....	.....	.....	.....	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Tested for amount of pigment only.
46.6	2.3	13.5	35.0	Trace	.....	.....	.....	.....	.....	.....	.....	

TESTS OF PAINTS—1914.

Per cent of pigment by weight.	Per cent of vehicle by weight.	Analysis of pigment.							Tests on vehicle.		Remarks.
		Lead sulphate in per cent.	Lead sulphite in per cent.	Lead sulphide in per cent.	Lead oxide in per cent.	Zinc oxide in per cent.	Iron oxide and aluminum oxide in per cent.	Carbon and volatile matter in per cent.	Specific gravity at 15.5°C.	Flash point in open cup in °C.	
91.9	8.1	75.0	.....	.....	17.4	5.4	.....	.....	.....	.....	Sublimed white lead, paste form.
55.9	44.1	80.0	.....	.....	14.5	3.5	.....	.....	.....	300	
51.2	48.8	53.6	2.0	5.8	35.3	.....	.....	1.8	.....	270	
59.6	40.4	53.2	0.2	7.4	35.3	0.6	.....	2.3	.....	275	
55.4	44.6	46.0	6.1	5.4	37.2	0.8	0.5	1.7	.....	280	
.....	.....	49.8	2.8	6.2	39.4	0.6	.....	.....	.....	.....	Dry pigment.
.....	.....	.....	.....	.....	.....	.....	.....	.....	0.935	297	
55.6	44.4	48.8	2.1	6.8	36.4	1.0	0.6	0.4	.....	.....	
59.3	40.7	48.1	7.0	5.2	35.6	1.4	.....	1.1	.....	.....	
91.8	8.2	77.2	.....	.....	16.1	5.4	.....	.....	.....	.....	Sublimed white lead, paste form.

TABLE XXIV—TESTS

Laboratory number.	Trade name.	Furnished by—	Submitted by—	Per cent of pigment by weight.	Per cent of vehicle by weight.
1115	Corroded White Lead in Oil	.....	Lintz Bros., Fort Branch, Ind.	91.4	8.6
1136	Sublimed Blue Lead in Oil.	Phelan-Faust Paint Mfg. Co., St. Louis, Mo.	East St. Louis Bridge Co., East St. Louis, Ill.	88.9	11.1
1169	Sublimed White Lead in Oil	.....	Lintz Bros., Fort Branch, Ind.	89.6	10.4
1213	Basic Lead Sulphate.....	St. Louis Smelting & Refining Co., St. Louis, Mo.	Vincennes Bridge Co., Vincennes, Ind.	100.0	.....
1214	Basic Lead Sulphate.....	..do.....	..do.....	100.0	.....
1248	Boiled Linseed Oil.....	American Linseed Oil Co., Chicago, Ill.	Manufacturer.....	.....	.....
1383	Sublimed White Lead in Oil	Smith-Alsop Paint & Varnish Co., Terre Haute, Ind.	.....	85.2	14.8
1392	Sublimed White Lead in Oil	John Lucas & Co., Chicago, Ill.	John Lucas & Co., Chicago, Ill.	56.3	43.7
1409	Sublimed White Lead in Oil	Indianapolis Paint & Color Co., Indianapolis, Ind.	Central States Bridge Co., Indianapolis, Ind.	54.7	45.3
1412	Linseed Oil.....	.....	H. V. Schoonover, Havana, Ill.	.....	.....
1596	Sublimed Blue Lead Paint.	.....	F. R. Bryant, Princeton, Ill.	52.0	48.0
1633	Sublimed Blue Lead Paint.	John H. Witte, Burlington, Ia.	A. R. Carter, Rockford, Ill.	54.8	45.2
1696	Sublimed Blue Lead Paint.	.....	W. E. Hill, Metropolis, Ill.	55.9	44.1
1716	Sublimed Blue Lead Paint.	Heath-Milligan Mfg. Co., Chicago, Ill.	W. J. Cox, Metropolis, Ill..	52.7	47.3
1725	Sublimed White Lead Paint	Becker-Moore Paint Co., St. Louis, Mo.	Missouri Bridge & Iron Co., St. Louis, Ill.	53.1	46.9
1743	Sublimed White Lead Paint.	..do.....	..do.....	58.4	41.6
1752	Sublimed Blue Lead Paint.	Otley Paint Mfg. Co., Chicago, Ill.	Manufacturer.....	60.3	39.7
1780	Sublimed Blue Lead Paint.	..do.....	..do.....	49.9	50.1
1782	Sublimed Lead Paint, 1st Coat.	Devoe & Raynolds Co., Chicago, Ill.	..do.....	42.0	58.0
1783	Sublimed Lead Paint, 2d Coat.	..do.....	..do.....	59.8	40.2
1784	Sublimed Blue Lead Paint.	Eberson-Lindsley Paint Co. St. Louis, Mo.	..do.....	54.3	45.7
1785	Sublimed Blue Lead Paint.	..do.....	..do.....	53.5	46.5
1792	Sublimed Blue Lead Paint.	.....	G. N. Lamb, St. Charles, Ill.	54.3	45.7
1793	Sublimed White and Blue Lead Paint.	.....	..do.....	18.5	81.5
1794	Special White Sublimed Lead Paint..	C. R. Cook Paint Co., Kansas City, Mo.	Manufacturer.....	41.5	58.5
1795	Special Blue Sublimed Lead Paint.	..do.....	..do.....	55.1	44.9
1796	Sublimed Blue Lead Paint.	.....	J. E. Demuth, Kell, Ill....	58.9	41.1
1805	Watertite Brand Sublimed Lead, 1st and 3d Coat.	Black Diamond Paint & Varnish Works, Evansville, Ind.	Manufacturer.....	54.2	45.8
1806	Watertite Brand Sublimed Lead, 2d Coat.	..do.....	..do.....	59.2	40.8

Analysis of pigment.							Tests on vehicle.		Remarks.
Lead sulphate in per cent.	Lead sulphite in per cent.	Lead sulphide in per cent.	Lead oxide in per cent.	Zinc oxide in per cent.	Iron and aluminum oxide in per cent.	Carbon and undetermined.	Flash point in °C. open cup.	Iodine number.	
.....	.....	.....	85.4	.....	.....	14.6	.....	.....	10 per cent CO_2, paste form.
50.4	1.7	7.0	35.6	1.8	0.3	3.2	.....	.....	Paste form.
73.5	0.1	.....	17.1	5.2	.....	4.1	.....	.....	Paste form.
78.9	.....	.....	15.4	4.9	.....	0.8	.....	.....	Dry pigment.
40.5	2.3	15.7	33.0	.....	.....	6.6	.....	.....	Dry blue pigment.
.....	.....	.....	.....	.....	.....	.....	293	.....	Specific gravity at 15.5°C.=.937; saponification No.=199.
70.2	.....	.....	13.5	9.0	.....	7.3	.....	.....	Paste form.
77.5	.....	.....	14.5	6.0	.....	2.0	148	.....	Not pure linseed oil.
79.8	.....	.....	13.9	5.3	.....	1.0	290	.....	
.....	.....	.....	.....	.....	.....	.....	272	.....	Saponification No.=194.
47.2	0.4	11.9	36.5	1.5	0.4	2.1	300	.....	
42.4	2.4	14.9	34.0	1.1	0.8	4.4	.....	.....	
Trace	Trace	.....	78.1	Trace	.....	21.9	.....	.....	Tinted corroded white lead.
49.1	Trace	10.9	32.8	1.3	.....	5.9	50	.....	Vehicle contains turpentine and dryer.
48.0	1.5	2.1	17.2	3.0	0.5	27.7	.....	.....	
77.4	.....	.....	16.1	5.3	.....	1.2	130	.....	Not pure linseed oil.
49.5	1.2	7.6	33.8	1.1	.....	3.8	250	.....	
48.5	2.2	10.3	33.8	0.9	.....	4.3	260	176	
51.3	1.6	9.5	29.7	0.8	1.6	5.5	285	176	
74.8	0.5	5.6	13.8	3.0	0.6	1.7	285	172	
54.0	3.0	5.1	35.3	0.8	0.4	1.4	273	159	
68.5	1.5	4.0	19.1	5.3	.....	1.6	287	167	
54.5	3.7	4.1	35.7	0.6	0.2	1.2	.....	.....	
71.3	1.5	2.2	16.8	5.1	.....	3.1	.....	172	
71.9	0.1	3.6	20.0	3.6	.....	0.8	279	183	
48.2	2.4	11.3	33.0	0.9	.....	4.2	270	176	
55.4	0.9	7.7	32.5	0.8	0.4	2.3	.....	170	
48.7	Trace	12.2	31.5	2.4	0.3	4.9	.....	.....	Oil free from pigment could not be obtained.
53.9	Trace	5.1	13.3	11.5	0.3	15.9	.....	.....	Oil free from pigment could not be obtained.

TABLE XXV—

Laboratory number.	Trade name.	Furnished by—	Submitted by—	Per cent of pigment by weight.	Per cent of vehicle by weight.
1811	Special White Sublimed Lead Paint.	C. R. Cook Paint Co., Kansas City, Mo.	C. R. Cook, Paint Co., Kansas City, Mo.	39.2	60.8
1815	Waterlite Brand Sublimed Lead Paint.	Black Diamond Paint & Varnish Co., Cincinnati, Ohio.	Black Diamond Paint & Varnish Co., Cincinnati, Ohio.	54.5	45.5
1842	Carbonizing Coating for Iron and steel.	The Coheen Mfg. Co., Canton, Ohio.	The Coheen Mfg. Co., Canton, Ohio.	53.8	46.2
1843	Carbonizing Coating for Iron and Steel.	..do	..do	45.1	54.9
1851	Sublimed White Lead Paint		Rock Island Bridge & Iron Co., Rock Island, Ill.	65.5	34.5
1856	Sublimed Blue Lead Dry Pigment.	The Globe Mfg. Co., Peoria, Ill.	The Globe Mfg. Co., Peoria, Ill.	.....	.....
1859	Pure Boiled Linseed Oil	..do	..do	.....	.....
1860	Sublimed Blue Lead Paint.	Pitcher Blue Lead and Hirst & Begley Linseed Oil.	Rock Island Bridge & Iron Co., Rock Island, Ill.	53.5	46.5
1867	Sublimed White Lead in Oil	The Chicago White Lead & Oil Co., Chicago, Ill.	Continental Bridge Co., Peotone, Ill.	90.0	10.0
1868	Sublimed Blue Lead in Oil.	..do	..do	87.6	12.4
1869	"The King" Kettle Boiled Linseed Oil.	..do	..do	.....	.....
1876	Sublimed Blue Lead Paint.		N. S. Kocher, Rockton, Ill.	54.7	45.3
2114	Sublimed Blue Lead Paint..	The John Lucas Paint Co., Chicago, Ill.	The Northern Steel & Concrete Co., Freeport, Ill.	53.4	46.6
3128	Deer Head Blue Lead Bridge Paint.	The Evansville Paint & Varnish Co., Evansville, Ind.	The International Steel & Iron Co., Evansville, Ind.	55.1	44.9
3150	Sublimed Blue Lead Paint..		Bureau of Bridges, State Highway Dept.	.....	.....
3266	Mixed Paint for Second Coat	Eagle Pitcher Pigment, Hirst & Begley Linseed Oil.	Moline Paint Co., Moline, Ill.	47.2	52.8
3278	Bridge Paint		Bureau of Bridges, State Highway Dept.	48.4	51.6
3284	Sublimed Ready Mixed White and Blue Lead Paint.	The Indianapolis Paint & Color Co., Indianapolis, Ind.	H. B. Sennott, Danville, Ill.	57.1	42.9
3285	Sublimed Blue Lead Paint.	..do	..do	61.9	38.1
3413	Bridge Paint		Bureau of Bridges, State Highway Dept-	53.5	46.5
3522	Sublimed Blue Lead Paint..		..do	60.5	39.5
3533	Second Coat Paint	The Worden-Allen Co., Milwaukee, Wis.	The Worden-Allen Co., Milwaukee, Wis.	51.5	48.5
3534	Finish Coat Paint	..do	..do	52.7	47.3
3535	Sublimed Blue Lead Paint..		Decatur Bridge Co., Decatur, Ill.	45.6	54.4
3536	Sublimed Blue Lead Paint..	Louisville Lead & Color Co., Louisville, Ky.	..do	23.4	76.5
3544	Bridge Paint		Bureau of Bridges, State Highway Dept.	60.7	39.3

* About.

TESTS OF PAINTS—1916.

Analysis of Pigment.							Tests of vehicles.					Remarks.
Lead sulphate in per cent.	Lead sulphite in per cent.	Lead sulphide in per cent.	Lead oxide in per cent.	Zinc oxide in per cent.	Iron and aluminum oxides in per cent.	Carbon and undetermined.	Specific gravity at 15.5°C.	Iodine number.	Saponification number.	Flash point in °C. open cup.	Burning point in °C open cup.	
10.1	Trace	2.5	7.1	0.3	.....	.....	.....	187	.....	285	.....	Pigment contains approximately 80 per cent basic lead carbonate.
69.5	0.5	4.3	20.0	4.3	.....	1.4	.....	179	.....	280	.....	
32.3	1.1	1.1	7.4	2.6	0.3	1.4	0.950	182	204	275	.....	First coat paint.
27.9	0.9	4.2	14.7	2.8	0.6	48.9	0.950	182	203	274	.....	Second coat paint.
73.4	.....	.....	17.8	7.2	.....	1.6	0.945	185	199	287	.....	Saw Mill Bridge, Henry County.
53.8	2.6	4.2	37.8	0.6	.....	1.0	.....	.....	.....	.....	.....	Sugar Grove Bridge, Mercer County.
.....	.....	.....	.....	.....	.....	.....	0.940	177	195	290	.....	Sugar Grove Bridge, Mercer County.
48.7	2.0	9.2	31.6	1.7	1.0	5.8	0.954	180	188	284	.....	Saw Mill Bridge, Henry County.
74.0	.....	.....	16.1	8.1	.....	1.8	.....	.....	.....	.....	.....	Centennial Bridge No. 1, Iroquois County, O'Rourke Bridge, McHenry County.
52.9	0.5	6.5	35.5	1.0	.....	3.6	.....	.....	.....	.....	.....	Centennial Bridge No. 1, Iroquois County, O'Rourke Bridge, McHenry County.
.....	.....	.....	.....	.....	.....	.....	0.939	186	193	295	.....	Centennial Bridge No. 1, Iroquois County, O'Rourke Bridge, McHenry County.
55.6	1.9	4.5	33.0	1.3	0.5	3.1	0.958	190	189	286	.....	S. Rock River Bridge, Winnebago County.
54.0	1.7	5.4	34.9	1.0	0.5	2.5	0.951	184	192	282	.....	Old Steel Bridges, Winnebago County.
45.5	2.1	1.3	45.8	0.5	.....	4.8	0.960	187	189	150	295	
53.4	2.6	8.9	31.4	1.1	0.8	2.4	.....	.....	.....	.....	.....	McCue Bridge, Henry County.
68.3	0.8	4.0	19.2	5.8	.....	1.9	0.965	181	178	274	.....	Saw Mill Bridge, Henry County.
53.2	0.5	7.3	30.0	1.1	1.1	6.8	.....	168	171	128	.....	Neff's Ford Bridge, Clark County.
73.3	0.4	3.6	16.4	5.1	.....	1.2	.....	164	166	47	.....	Bridge on Section C, Vermilion County.
57.2	0.8	6.1	33.8	1.0	0.3	0.8	0.953	183	168	64	.....	Bridge on Section C, Vermilion County.
48.7	3.6	7.8	32.6	0.9	0.6	5.8	0.954	172	160	64	114	Cemetery Bridge, Christian County.
47.9	13.9	2.6	32.1	1.0	0.9	1.6	0.953	186	177	272	.....	Stewart Bridge, DeKalb County.
58.3	0.8	5.4	31.9	2.0	0.5	1.1	0.950	177	184	280	.....	State Street Bridge, Winnebago County.
55.9	2.7	6.4	32.6	0.7	0.8	0.9	0.948	181	185	265	.....	State Street Bridge, Winnebago County.
57.4	0.5	5.8	32.5	1.3	0.4	2.1	0.987	164	155	67	.....	Contains some benzine.
51.1	0.5	15.4	24.9	0.6	1.2	6.3	0.950	172	186	272	.....	
45.4	0.8	4.3	*20.0	8.3	0.8	.....	.....	152	160	60	.....	Ten Mile Bridge, Tazewell County, approximately 20 per cent, basic lead carbonate.

TABLE XXV—

Laboratory number.	Trade name.	Furnished by—	Submitted by—	Per cent of pigment by weight.	Per cent of vehicle by weight.
3568	Bridge Paint	International Steel & Iron Co., Evansville, Ind.	C. A. Penington, Taylorville, Ill.	51.9	48.1
3571	Bridge Paint	.....	Bureau of Bridges, State Highway Dept.	55.6	44.4
3587	Bridge Paint	.....	H. M. Butt, Galesburg, Ill.	21.9	78.1
3588	Sublimed Blue Lead Paint	The Otley Paint Mfg. Co., Chicago, Ill.	Decatur Bridge Co., Decatur Ill.	49.8	50.2
3589	Sublimed Blue Lead and White Lead Paint.	..do	..do	47.5	52.5
3603	Sublimed Blue Lead Paint, First Coat.	The Worden-Allen Co., Milwaukee, Wis.	A. R. Carter, Rockford, Ill.	52.0	48.0
3604	Sublimed Blue Lead Paint, Finish Coat.	..do	..do	52.3	47.7
3613	Sublimed Blue Lead Paint, Second Coat.	Central States Bridge Co., Indianapolis, Ind.	C. A. Penington, Taylorville, Ill.	11.7	88.3
3614	Sublimed Blue Lead Paint, Third Coat.	..do	..do	57.8	42.2
3629	Sublimed Blue Lead Paint	The Otley Paint Mfg. Co., Chicago, Ill.	Samples taken by Laboratory Inspector at Shops of Decatur Bridge Co., Decatur, Ill.	.....	.....
3630	Sublimed Blue Lead Paint	..do	..do	.....	.....
3653	Blue Lead Paint	East St. Louis Bridge Co., East St. Louis, Ill.	Bureau of Bridges, State Highway Dept.	60.3	39.7
3663	Sublimed Blue Lead Paint	.....	Continental Bridge Co., Peotone, Ill.	55.4	44.6
3665	Bridge Paint, First Field Coat.	Continental Bridge Co., Peotone, Ill.	Bureau of Bridges, State Highway Dept.	62.0	38.0
3666	Bridge Paint, Second Field Coat.	..do	..do	48.0	52.0
3668	Sublimed Blue Lead Paint	Evansville Paint & Varnish Co., Evansville, Ind.	Evansville Paint & Varnish Co., Evansville.	70.7	29.3
3692	Sublimed Blue Lead Paint	Wausau Iron Works, Wausau, Wis.	Bureau of Bridges, State Highway Dept.	56.1	43.9
3695	Sublimed White Lead Paint	.....	Continental Bridge Co., Peotone, Ill.	50.1	49.9
3696	Sublimed White Lead Pigment.	Campbell Glass & Paint Co., St Louis, Mo.	L. C. Kessler, Herrick, Ill.	.....	.....
3697	Sublimed Blue Lead Pigment.	..do	..do	.....	.....
3698	Improved Boiled Linseed Oil	..do	..do	.....	.....
3708	Standard Paint, First Coat.	The Sherwin-Williams Co., Cleveland, Ohio.	The Sherwin-Williams Co., Cleveland, Ohio.	57.3	42.7
3709	Standard Paint, Second Coat	..do	..do	58.1	41.9
3710	Standard Paint, Third Coat.	..do	..do	57.2	42.8

NOTE.—Four samples of Paint which were found on examination to be Coal Tar or Water Gas Tar Products are not included in these tests.

Concluded.

Analysis of pigment.							Test of vehicles.					Remarks.
Lead sulphate in per cent.	Lead sulphite in per cent.	Lead sulphide in per cent.	Lead oxide in per cent.	Zinc oxide in per cent.	Iron and aluminum oxides in per cent.	Carbon and undetermined.	Specific gravity at 15.5°C.	Iodine number.	Saponification number.	Flash point in °C. open cup.	Burning point in °C open cup.	
50.2	0.2	12.9	31.0	1.9	0.7	3.1	0.972	168	170	156	.....	Curvey Bridge, Christian County.
56.8	0.6	2.7	32.8	2.3	0.4	4.4	0.948	173	179	118	.....	Kessner Crossing Bridge Fulton County.
†	†	†	†	†	†	†	‡	‡	‡	‡	‡	Steel Bridges, Knox County.
53.7	1.7	5.0	34.9	0.9	0.3	3.5	0.962	173	177	276	.....	
78.2	0.5	1.9	12.4	4.6	0.3	2.1	0.964	175	171	276	.....	
58.4	0.3	4.5	32.8	2.3	0.5	1.2	.....	170	180	248	.....	State Street Bridge, Winnebago County.
54.4	1.2	4.6	36.3	0.9	0.6	2.0	0.949	177	184	156	280	State Street Bridge, Winnebago County.
74.9	1.2	1.4	12.9	5.6	0.3	3.7	0.929	168	163	65	74	Cemetery Bridge, Christian County.
55.1	2.8	3.0	35.3	1.1	0.3	2.4	0.936	158	165	78	104	Cemetery Bridge, Christain County.
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	258	.....	Tested for presence of benzine only.
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	275	.....	Tested for presence of benzine only.
46.7	1.0	4.1	20.0	7.5	0.8	.....	0.942	150	155	57	74	Ellis Bridge Macoupin County. Approximately 20 per cent, basic lead carbonate in pigment.
52.4	2.6	5.6	34.4	0.8	0.9	3.3	.....	171	180	289	.....	Bridge No. 7, Iroquois County.
73.0	1.2	0.4	17.1	5.1	0.3	2.9	.....	.....	.....	36	36	Bridge No. 7, Iroquois County.
49.9	4.2	4.6	35.6	1.4	0.8	3.5	0.946	174	185	287	.....	Bridge No. 7, Iroquois County.
45.7	1.2	1.1	47.2	0.7	0.2	3.9	.....	188	189	290	.....	Hale and Stevens Bridge McLean County.
43.5	0.4	2.0	3.6	1.9	21.45	5.0	0.933	168	179	68	118	Slough Bridge, LaSalle County. Pigment contains 22.15 per cent insoluble silicate (clay).
73.5	0.5	0.4	18.9	0.2	4.0	2.5	0.945	175	184	137	310	Bridge No. 7, Iroquois County.
75.4	.....	.....	17.2	6.2	0.2	1.0	.....	.....	.....	.....	.....	Ellis Bridge, Macoupin County.
54.6	1.9	2.3	38.1	1.0	0.3	1.8	.....	.....	.....	.....	.....	Ellis Bridge, Macoupin County.
.....	.....	.....	.....	.....	.....	.....	0.937	186	187	282	.....	Ellis Bridge, Macoupin County.
44.8	1.4	11.9	35.2	1.4	0.3	5.0	0.944	177	186	145	320	
71.3	0.2	1.8	17.6	6.9	0.2	2.0	0.944	177	184	142	320	
44.7	1.5	11.6	35.5	1.5	0.2	4.9	0.944	177	184	184	323	

† Graphite.
‡ Linseed Oil and Drier.

PART V

Bureau of Audits

REPORT OF THE BUREAU OF AUDITS.

(J. M. McCoy, Chief Clerk.)

The Bureau of Audits, besides being charged with the duty of keeping the accounts of the department, has under its direct supervision the work of the various clerks and stenographers, the ordering of all materials and supplies, the advertising of State aid contracts, handling the resolutions of county boards as regards State aid work, and the publication and distribution of bulletins and reports dealing with various phases of the work of the department.

In order to handle such work effectively, the following employees have been found necessary:

1 Chief clerk and auditor.
1 Chief stenographer.
Stenographers.
1 Bookkeeper.
1 Assistant bookkeeper.
3 Department clerks.
3 Engineering clerks.
1 Property clerk.
1 File clerk.
1 Department editor.
1 Telephone operator.
2 Messengers

STATE AID ESTIMATES.

The checking and preparation of vouchers in payment of engineer's estimates and cement invoices, and the keeping of proper records of same, entails a vast amount of detail, extreme carefulness, and prompt handling.

Once each month, the engineer in charge of each piece of State aid work, submits to his division engineer, an estimate of the value of the work performed by the contractor, during the previous month. This estimate is then checked by the division engineer for correctness, and if found to be correct, is approved and forwarded by him to the chief of the Bureau of Roads, or Bureau of Bridges according to the class of construction under way. The estimate is again checked and analyzed in order to verify the division engineer's figures, and if found to be correct, is approved by the bureau chief. After being approved, the estimate is forwarded to the Bureau of Audits where it is put in line for vouchering. If the work performed by the contractor is entirely satisfactory, vouchers are prepared and submitted to the Chief State Highway Engineer and State Highway Commission for approval. The voucher used for this purpose consists of two forms, one of which is addressed to the State Auditor of Public Accounts and the other to the

county clerk of the county in which the work is located, and which authorizes the payment of the amount of money which is to be paid by the State and county respectively.

The forms as mentioned consist of an order to pay, together with a detailed statement showing the amount of the original contract, additional contracts, value of extra work and deductions made from the contract. They also show the estimated value of the work completed at the time of vouchering, previous payments made on the contract, sack deductions, a 10 per cent deduction (withheld on all contracts until finally completed) and the net amount due the contractor.

The net amount due the contractor is then divided between the State and county, the amount to be paid by the State never being in excess of 50 per cent as is provided in the State Road and Bridge Laws.

CEMENT RECORDS.

Under the contracts of the State Highway Department with the various cement companies, shipments of cement are made either in cloth or paper sacks. Where they are made in cloth it is necessary to keep a strict account of the sacks shipped to each job and by whom; as each sack is charged for at the rate of 10 cents. These sacks are in turn charged by the State Highway Department to the contractor and upon receipt of payment estimate the value of all sacks shipped to each particular job at the time the estimate is received is deducted from the amount due the contractor.

Invoices covering cement shipments for use on State aid work are mailed to this bureau, where they are checked to see that the shipment is made by the proper company, is billed at the correct price (in conformance with the contracts), and that all extensions are correct. After being checked, they are entered on record cards, one card being used for each section of State aid work.

These cards show the date of shipment, car number, car initials, number of barrels contained in the car, date car was reported as arrived and inspected, and date on which same was vouchered. They also show the name of the contractor on the work, shipping point, the total number of barrels required and the name of the county and section to which the cement is shipped.

In handling these forms a strict watch is kept to see that the amount shipped to any particular section does not exceed the theoretical amount required.

A form has been provided for the use of resident engineers in reporting the arrival of cement cars. These forms show the name of the county and section on which the cement is to be used, the condition of cars, the date of arrival, car number, car initials, name of company making shipment and the number of barrels received. Each resident engineer at the end of each week reports to this bureau as to the cars received during that week. These reports are then checked against the cement records and if the invoices as recorded agree with reports of the engineers they are vouchered and presented to the Chief State Highway Engineer

and State Highway Commission for approval; the forms of voucher in use being similar to those used for vouchering estimates.

CORRESPONDENCE AND CLERICAL WORK.

All mail addressed to the Highway Department, and not directed to any particular bureau is received, opened and read by the chief clerk. It is then submitted to the Chief State Highway Engineer or forwarded to the proper bureau chief for attention. Formerly, before the organization of the department into the five bureaus, all mail was received by the chief clerk, and from one to three hours time were required to properly assort the correspondence. Under the plan of five character divisions, the majority of letters are addressed directly to the proper bureau, thereby facilitating greatly the work of the entire department. Increased efficiency in handling inter-departmental mail has also been secured by the use of colored envelopes, using a separate color for each bureau. This system has been found to be of great convenience, as the mail can be easily sorted for distribution according to the color of the envelope used.

ORDERING SUPPLIES AND MATERIAL.

All supplies and materials for the entire department are ordered through this bureau on requisitions signed by the chief of the bureau desiring the order and approved by the Chief State Highway Engineer.

Quite a saving has been effected by thus centralizing the purchasing power of the entire department, as it has been possible to buy in much larger quantities, thereby securing a lower price.

RESOLUTIONS OF COUNTY BOARDS.

The work of looking after the resolutions passed by the various county boards as regards State aid road work has been no small item of the work of this bureau. It has been an arduous task to devise an efficient yet simple system of obtaining this very necessary information.

TABLE I—SHOWING APPROPRIATIONS MADE BY LEGISLATURE FOR GENERAL OPERATING EXPENSE.

Purpose of appropriation.	Date available.	Amount appropriated.	Total appropriated.	Total expended.	Balance.	Lapsed to State treasury.
General expense	July 1, 1913	$ 69,500 00				
General expense	July 1, 1914	69,500 00	$139,000 00	$138,988 88	$ 11 12	
Incidental expense	July 1, 1915	20,135 00				
Incidental expense	July 1, 1916	20,135 00	40,270 00	39,145 85	1,124 15	
Traveling expense	July 1, 1915	55,180 00				
Traveling expense	July 1, 1916	55,180 00	110,360 00	82,759 13	27,600 87	
Contingent expense	July 1, 1915	5,000 00				
Contingent expense	July 1, 1916	5,000 00	10,000 00	3,447 67	6,552 33	
Postage expense	July 1, 1915	5,000 00				
Postage expense	July 1, 1916	5,000 00	10,000 00	5,350 00	4,650 00	
Salaries expense	July 1, 1913	30,500 00				
Salaries expense	July 1, 1914	30,500 00				
Salaries expense	July 1, 1915	114,685 00				
Salaries expense	July 1, 1916	114,685 00	290,370 00	259,507 89	30,862 11	
Total		$600,000 00	$600,000 00	$529,199 42	$70,800 58	

FOR EXPERIMENTAL ROADS.

Biological laboratory road	July 1, 1913	$7,500 00	$7,500 00	$7,498 33		$1 67

FOR STATE AID CONSTRUCTION.

State road and bridge fund	July 1, 1913	$ 400,000 00				
	July 1, 1914	700,000 00				
	July 1, 1915	1,000,000 00				
	July 1, 1916	1,000,000 00	$3,100,000 00	$1,740,251 62	$1,359,748 38	
Grand total		$3,707,500 00	$3,707,500 00	$2,276,949 37	$1,430,548 96	$1 67

PROPERTY SCHEDULE OF THE DEPARTMENT.

Office furniture and fixtures	$ 8,726 55
Laboratory furniture and fixtures	2,204 91
Field instruments and equipment	9,067 09
Road machinery and maintenance equipment	38,746 43
Total	$58,744 98

THE ALLOTMENT.

The allotment for each county is made from the moneys appropriated for the purpose by the General Assembly. The money so appropriated is obtained in the first instance mainly from the moneys received under the Motor Vehicles Act. This money constitutes the road fund and is distributed or allotted among the counties of the State. In counties in which over 40 per cent of the road fund is collected, 25 per cent of this amount constitutes the allotment. The remainder of the road fund is allotted to the remaining counties in the same ratios as their road and bridge taxes were when levied.

Before the county receives the allotment it is required to provide and appropriate not less than an equal amount, but may furnish any amount in excess or donations may be received from any townships, cities, villages, corporations, or individuals.

In case a county refuses to accept its allotment or neglects to accept it within six months after it becomes available (July 1 of each year) such county forfeits its allotment to the State for re-distribution, which re-allotment is effected in a similar manner as the original allotment, omitting from consideration, however, those counties which forfeited the allotment.

The allotment is considered accepted if the county board notifies the State Highway Commission that it has assessed a tax to raise its portion, or passed an order submitting the question of raising such funds by taxation, or of issuing bonds for the purpose in view.

TABLE II—SHOWS THE AMOUNT OF MONEY ALLOTTED TO THE DIFFERENT COUNTIES OF THE STATE BY THE STATE HIGHWAY COMMISSION FOR STATE AID ROAD CONSTRUCTION; THE AMOUNT FORFEITED ON ACCOUNT OF NON-ACCEPTANCE OF STATE AID ALLOTMENT; AND THE ACTUAL REALLOTMENT MADE OF MONEY FORFEITED, BY THE STATE HIGHWAY COMMISSION.

County.	1913 allotment.	1914 allotment.	Forfeitures.	Re-allotments.	Forfeitures.	1915 allotments.	Forfeitures.	1916 allotments.
Adams	$ 3,584 00	$ 6,272 00		$ 1,182 00		$ 9,591 00		$ 9,591 00
Alexander	1,183 00	2,070 00		390 00		10,390 00		10,390 00
Bond	1,854 00	3,245 00		611 00		4,334 00		4,334 00
Boone	1,679 00	2,938 00		554 00		5,808 00		5,808 00
Brown	957 00	1,675 00	$ 2,632 00			2,799 00		2,799 00
Bureau	7,730 00	13,528 00		2,550 00		19,764 00		19,764 00
Calhoun	389 00	681 00		128 00		1,596 00		1,596 00
Carroll	2,828 00	4,949 00		933 00		7,407 00		7,407 00
Cass	1,283 00	2,246 00		423 00		6,893 00		6,893 00
Champaign	9,406 00	16,461 00		3,104 00		20,676 00		20,676 00
Christian	5,397 00	9,445 00	14,842 00			12,912 00		12,912 00
Clark	1,925 00	3,369 00		635 00		5,446 00		5,446 00
Clay	1,199 00	2,098 00		395 00	$ 395 00	3,487 00		3,487 00
Clinton	2,214 00	3,874 00		730 00		4,851 00		4,851 00
Coles	3,063 00	5,360 00		1,010 00		8,905 00		8,905 00
Cook	43,750 00	76,570 00		14,438 00		108,994 00		108,994 00
Crawford	6,584 00	11,522 00		2,172 00		4,904 00		4,904 00
Cumberland	1,127 00	1,972 00	845 00			3,220 00		3,220 00
DeKalb	6,059 00	10,603 00		1,999 00		15,482 00		15,482 00
DeWitt		9,000 00	9,000 00			7,920 00		7,920 00
Douglas	3,434 00	6,010 00		1,133 00		7,951 00		7,951 00
DuPage	5,396 00	9,443 00		1,780 00		11,266 00		11,266 00
Edgar	4,791 00	8,384 00		1,581 00		13,529 00		13,529 00
Edwards	477 00	835 00		157 00		1,552 00		1,552 00
Effingham	2,099 00	3,673 00		692 00		3,904 00		3,904 00
Payette	2,795 00	4,891 00		922 00	922 00	7,253 00		7,253 00
Ford	2,859 00	5,003 00		943 00		8,503 00		8,503 00
Franklin	1,848 00	3,234 00		609 00		6,185 00		6,185 00
Fulton	7,022 00	12,288 00		2 317 00		11,811 00		11,811 00
Gallatin	950 00	1,662 00		313 00		2,267 00		2,267 00
Greene	2,871 00	5,024 00	5,025 00			7,049 00		7,049 00
Grundy	3,849 00	6,736 00		1,270 00	1,270 00	8,841 00		8,841 00
Hamilton	1,391 00	2,434 00		459 00		3,489 00	3,489 00	3,489 00
Hancock	4,389 00	7,680 00	7,069 00			9,719 00		9,719 00
Hardin	150 00	262 00		49 00		661 00		661 00

Henderson	2,092 00	3,661 00	5,753 00			5,107 00	2,857 00	5,107 00
Henry	5,612 00	9,821 00		1,851 00		13,027 00		13,027 00
Iroquois	10,016 00	17,528 00		3,305 00		19,294 00		19,294 00
Jackson	2,196 00	3,843 00		724 00		7,880 00		7,880 00
Jarper	1,298 00	2,271 00		428 00		4,052 00		4,052 00
Jefferson	1,520 00	2,660 00		501 00		5,124 00		5,124 00
Jersey	1,152 00	2,016 00		380 00		3,808 00		3,808 00
JoDaviess	2,723 00	4,766 00		898 00		6,285 00		6,285 00
Johnson	514 00	899 00		169 00	169 00	984 00		984 00
Kane	9,600 00	16,800 00		3,168 00		23,582 00		23,582 00
Kankakee	4,140 00	7,245 00		1,366 00		10,394 00		10,394 00
Kendall	3,032 00	5,306 00		1,000 00		6,050 00		6,050 00
Knox	4,430 00	7,752 00	12,182 00			11,624 00		11,624 00
Lake	5,638 00	9,867 00		1,860 00		11,953 00		11,953 00
LaSalle	12,393 00	21,688 00		4,089 00		28,384 00		28,384 00
Lawrence	2,358 00	4,126 00		778 00		6,647 00		6,647 00
Lee	4,210 00	7,367 00		1,389 00		10,461 00		10,461 00
Livingston	5,417 00	9,480 00		1,787 00		15,880 00		15,880 00
Logan	5,127 00	8,972 00		1,691 00		10,936 00		10,936 00
McDonough	2,738 00	4,791 00		903 00		7,987 00		7,987 00
McHenry	5,194 00	9,089 00		1,713 00		12,956 00		12,956 00
McLean	9,509 00	16,641 00	26,150 00			24,196 00		24,196 00
Macon	6,653 00	11,642 00	18,295 00			16,683 00		16,683 00
Macoupin	4,258 00	7,451 00		1,405 00		11,027 00		11,027 00
Madison	7,352 00	12,866 00		2,426 00		15,469 00		15,469 00
Marion	2,300 00	4,025 00		759 00		6,042 00		6,042 00
Marshall	2,387 00	4,177 00		787 00		6,118 00		6,118 00
Mason	2,531 00	4,429 00	6,960 00			5,336 00		5,336 00
Massac	538 00	942 00		177 00		1,552 00		1,552 00
Menard	1,155 00	2,022 00		381 00		3,657 00		3,657 00
Mercer	3,698 00	6,471 00		1,220 00	1,220 00	9,085 00		9,085 00
Monroe	861 00	1,507 00		284 00		2,896 00		2,896 00
Montgomery	4,554 00	7,969 00	7,523 00			10,818 00		10,818 00
Morgan	2,602 00	4,554 00		858 00		9,304 00		9,304 00
Moultrie	2,089 00	3,655 00		689 00		5,626 00		5,626 00
Ogle	5,198 00	9,096 00		1,715 00		12,949 00		12,949 00
Peoria	9,551 00	16,714 00		3,151 00		21,744 00		21,744 00
Perry	838 00	1,467 00		276 00		2,618 00		2,618 00
Piatt	3,067 00	5,367 00		1,012 00		7,223 00		7,223 00
Pike	2,862 00	5,008 00		944 00	444 00	8,664 00		8,664 00

TABLE II—Concluded.

County.	1913 allotment.	1914 allotment.	Forfeitures.	Re-allotments.	Forfeitures.	1915 allotments.	Forfeitures.	1916 allotments.
Pope	$ 360 00	$ 630 00	.....	$ 118 00	.....	$ 1,243 00	.....	$ 1,243 00
Pulaski	544 00	952 00	.....	179 00	.....	1,987 00	.....	1,987 00
Putnam	1,042 00	1,823 00	.....	343 00	.....	2,585 00	.....	2,585 00
Randolph	1,032 00	1,806 00	.....	340 00	.....	3,615 00	.....	3,615 00
Richland	.....	2,555 00	$2,555 00	.....	.....	3,337 00	.....	3,337 00
Rock Island	2,601 00	4,552 00	.....	858 00	.....	6,285 00	.....	6,285 00
St. Clair	5,113 00	8,948 00	.....	1,687 00	.....	10,085 00	.....	10,085 00
Saline	2,638 00	4,616 00	.....	870 00	.....	8,462 00	.....	8,462 00
Sangamon	6,692 00	11,711 00	.....	2,208 00	.....	17,010 00	.....	17,010 00
Schuyler	2,105 00	3,684 00	.....	694 00	.....	4,587 00	.....	4,587 00
Scott	757 00	1,324 00	.....	249 00	.....	3,370 00	.....	3,370 00
Shelby	3,556 00	6,223 00	.....	1,173 00	.....	11,904 00	.....	11,904 00
Stark	2,001 00	3,502 00	.....	660 00	.....	5,097 00	.....	5,097 00
Stephenson	2,857 00	5,000 00	.....	942 00	.....	10,348 00	.....	10,348 00
Tazewell	4,298 00	7,521 00	.....	1,418 00	.....	9,240 00	.....	9,240 00
Union	589 00	1,031 00	.....	194 00	.....	2,526 00	.....	2,526 00
Vermilion	11,082 00	19,394 00	.....	3,657 00	.....	29,482 00	.....	29,482 00
Wabash	1,089 00	1,906 00	.....	359 00	.....	2,846 00	.....	2,846 00
Warren	4,678 00	8,187 00	.....	1,543 00	.....	9,069 00	.....	9,069 00
Washington	1,948 00	3,409 00	3,557 00	.....	.....	4,356 00	.....	4,356 00
Wayne	1,812 00	3,171 00	.....	597 00	$597 00	5,844 00	.....	5,844 00
White	2,978 00	5,211 00	.....	982 00	.....	4,531 00	.....	4,531 00
Whiteside	4,780 00	8,365 00	.....	1,577 00	.....	13,741 00	.....	13,741 00
Will	8,318 00	14,556 00	.....	2,744 00	.....	17,772 00	.....	17,772 00
Williamson	2,460 00	4,305 00	.....	811 00	.....	5,440 00	.....	5,440 00
Winnebago	7,599 00	13,298 00	.....	2,507 00	.....	14,042 00	.....	14,042 00
Woodford	2,934 00	5,134 00	.....	968 00	.....	8,415 00	.....	8,415 00
Total	$395,798 00	$704,202 00	$122,388 00	$115,241 00	$5,017 00	$990,000 00	$6,346 00	$990,000 00

SUMMARY.

Appropriation available July 1, 1913	$ 400,000.00
Appropriation available July 1, 1914	700,000.00
Appropriation available July 1, 1915	1,000,000.00
Appropriation available July 1, 1916	1,000,000.00
Total appropriations	$3,100,000.00
1913, Allotment to counties	$ 395,798.00
1914, Allotment to counties	704,202.00
1915, Allotment to counties	990,000.00
1916, Allotment to counties	990,000.00
Withheld for maintenance purposes from 1915 and 1916 appropriations	20,000.00
	$3,100,000.00

REMARKS.

In order that counties may be allotted definitely their apportionment, it is necessary that county boards take action as follows:

First—Appoint a county superintendent of highways as no county can receive an allotment which has not appointed a county superintendent of highways.

Second—Submit a map showing the main roads of the county, the roads so selected and designated to connect the main trading points and principal cities of the county and also are to connect the principal cities with neighboring counties.

Out of the total of $1,100,000.00 which was allotted to the counties in 1913 and 1914, $122,388.00 was forfeited through failure of the county boards to meet their full allotment or a part of same.

On February 10, 1915, the State Highway Commission reallotted from the amounts not accepted $115,241.00.

Four thousand five hundred ninety-two dollars of the non-accepted amounts was set aside for maintenance purposes leaving a contingent fund of $2,555.00 remaining in the State road and bridge fund.

Of the amounts reallotted seven counties failed to accept all or part, and these amounts will revert to the State road and bridge fund to be used for maintaining State aid roads.

It will be noted that out of all allotments made July 1, 1915, but two counties, namely, Hamilton and Henderson failed to provide equal amounts to meet their apportionment, the amount so forfeited totalling $6,346.00.

The forfeitures from the 1915 allotment will revert to the State road and bridge fund and will be reallotted along with the non-acceptance of the allotments to be made for State aid construction in 1916.

THE PRELIMINARY RESOLUTION.

The first step in the construction of a section of State aid road or bridge, is the preliminary resolution. Normally the preliminary resolution would be passed after the acceptance of the allotment but in many cases, the preliminary comes first, principally on account of the time allowed (6 months) in which to make the acceptance. The form of preliminary herewith given complies with the provision of the law. Certification of the copy sent to the Highway Commission is required. This resolution contains principally a description of the section of road to be constructed, but certain other information is incorporated into it as follows: The resolution of the county board as to the type of road

to be constructed and a certification that there has been published for two consecutive issues once each week in two newspapers having the largest circulation in the county, detailed estimates of the cost in the county of the various types of road now to be specified. The type of road selected may be either permanent earth improvement (including surface or subsurface drainage, grading, leveling and crowning), gravel, macadam, concrete, concrete and macadam combined or brick. Such type, when selected is the final decision of the county board, not subject to change by the State Highway Commission, and must be adhered to throughout the entire length of the road, that is from one main objective or connecting point to another within the county.

The county board or county commissioners have the option, in case of disagreement or in case they do not desire to exercise the privilege and power of selecting the type, of delegating this function to the State Highway Commission whose decision shall be as final and binding as if made by the county board. In case there should be any donations from townships, cities, villages, corporations or individuals, the county board is authorized to accept the same. When such donations have been received, the county may elect to pay more than its 50 per cent by passing a resolution to that effect and filing a copy of same with the State Highway Commission at the time of filing the preliminary resolution. After receiving the preliminary resolution, the description of the section of road written upon the same is carefully checked over by the engineer in charge of such work, reference being had to the official maps of State aid routes selected by the county boards and revised by the State Highway Commission, by the county boards, or both in accordance with the provisions of the law. Any errors found in the description are corrected and the revised resolution returned for ratification by the county board, or the proper changes made by authorization of the board. After the resolution has been found to be in correct form, or is made so, it is taken under consideration by the State Highway Commission, who, if they approve, make the proper certification to that effect. Before such approval is made, however, a thorough examination of the road in question is made by the division engineer of the engineering division in which the county lies, and the result of such examination or reconnoisance is transmitted to the State Highway Commission. This report gives the details of the general nature of the improvements necessary along the proposed road, and indicates whether or not the proposed improvement will be of public utility and convenience and whether its construction is practicable. Upon receipt of this report the resolution is disapproved or the approval is made in proper form as above explained with such modifications that may be necessary to conform to the natural conditions as presented by the preliminary examination. After the approval has been made, the State Highway Commissioners direct the State Highway Engineer to cause proper surveys to be made and to prepare suitable maps, plans, specifications and estimates of cost of the proposed improvement.

The value of all material directly contracted for by the State or the rental of any State machinery which is deemed necessary for the completion of the work, is included in the cost estimate. Upon completion

of the maps, plans, etc., the State Highway Engineer makes a complete report of the same to the State Highway Commission, and sends a copy of the report to the county board.

FINAL RESOLUTION OF STATE HIGHWAY COMMISSION.

Upon receipt of the report of the State Highway Engineer, the State Highway Commission finally determines whether or not they will authorize the construction of the proposed improvement as a State aid road. The decision reached is put in the form of a resolution and a copy sent to the county board.

FINAL RESOLUTION OF COUNTY BOARD.

After the receipt of the final resolution of the State Highway Commission by the county board, the county board may at any regular or special meeting authorize the proceedings necessary to enable the county to contribute one-half the cost of the road to be constructed, or a greater proportion if the county desires. The funds necessary may be appropriated from the county treasury if there are sufficient in the same for that purpose. It is expressly forbidden to expend for any other purpose any moneys appropriated by the county board for State aid roads or any moneys raised by taxation for this purpose.

The county board may also submit the question of issuing bonds for State aid roads.

The county clerk notifies the State Highway Commission of the action of the county board in passing the final resolution. For convenience this notice is now made a part of the final resolution.

The State does not exercise control over the roads until the above formal proceedings have been completed, and after such procedure the construction and improvement of the State aid roads is taken up and carried forward as far as practicable in the consecutive order of the date of receipt by the commission, of the certified copies of the final resolutions of the county board.

After the final resolution has been adopted by the county board, no subsequent resolution can rescind or annul it, excepting with the advice and consent of the State Highway Commission.

PUBLICATIONS.

Another very important feature of the work of this bureau is the publication of bulletins dealing with various phases of road work. In April, 1914 the department undertook the publication of a 16-page monthly official bulletin *"Illinois Highways,"* the purpose of which is to disseminate information of service to road officials and workers, and to any others who are interested in improving the highways. This bulletin has been found to be of much benefit in keeping interested persons advised as regards what is being done toward improving the highways and also as to how it is being done.

The magazine devotes its pages not only to technical articles on road construction and maintenance, but carries also numerous articles of general interest to anyone concerned in improved roads.

Approximately 9,500 of these bulletins are distributed monthly and the good which is secured through this medium warrants the continuance of this publication.

MISCELLANEOUS.

The advertising of all State aid contracts is done through this bureau, mailing lists of the names of contractors are kept and notices of State aid construction work are mailed in ample time to enable the contractors to make an intelligent bid on the work.

Much time is spent, also, in advising with various county and township officials as to the steps to take in carrying out their work.

At the direction of the Chief State Highway Engineer this bureau prepared a set of uniform accounting forms for the use of township and district officials in keeping their records.

These forms have been made as simple as possible and yet comprehensive enough to provide for all conditions.

This system embodies the use of eight accounting forms which are explained in the following paragraphs.

Modern business methods require the taking of an inventory at least once each year; therefore, to carry on the work of the townships in a businesslike manner, it is deemed advisable that an inventory of all machinery, tools, etc., be made the first of May each year. A copy of this inventory is to be furnished the county superintendent of highways in order that he may know what machinery, tools, etc., are available to the townships. This inventory is reported on Form No. 1.

Form No. 2, which is the basis of the entire system, is a statement made by a commissioner of highways, who supervises or authorizes any highway work done in his township, to the board of highway commissioners and who certifies thereon the amount of work done, by whom done, the amount to be paid, and, on the reverse side, shows a classification of the work. It is intended that these statements may cover the work of any one man for a period of a month if it is desired to make monthly payments for work done.

Upon the approval of such a certified statement by the commissioners of highways an order is issued on the treasurer of the road and bridge fund of the township (Form No. 3) directing him to pay the amount certified on the original statement and also indicating the items for which this amount has been expended.

The treasurer then enters in his book the disbursements as indicated on the order.

It might be well to note also that space is provided on this order for the signature of the town clerk. This signature is not required by law, but it has been deemed advisable to have it appear in order that the treasurer may know that the town clerk has a proper record of such order, as, if no record has been made of it, the order is invalid.

The treasurer's book consists of two sections, Form 4a and 4b. Form 4a comprises the first section of the book and provides for the recording of the receipts and a summary of disbursements.

Form 4b, comprising the latter part of the book, contains a classification for the distribution of the expenditures as recorded in the order.

The county superintendent of highways, in order to carry on properly the duties of his office, must know definitely the amount of money which is available in the township treasury and must know also the items for which expenditures have been made. The town clerk keeps the record of the business transacted by the highway commissioners and is therefore the only official to report to the county superintendent of highways regarding the receipts and expenditures of the various funds or such other information as is required. This information is recorded monthly on Form No. 5 by each township or district clerk. The county superintendent, upon receiving these reports, records a summary of them in his own book, Form No. 6. Thus he can note at a glance the exact financial condition of any township or district and is thereby enabled to pass more intelligently upon contracts wherein the amount of money involved exceeds $200 as provided by law and is also in a position to render a more intelligent report to the county board of the work of the various townships of the county.

In giving his approval of contracts and purchases made by the commissioners in excess of $200, the county superintendent uses a standard approval sheet, Form No. 7. This system contemplates that all contracts be made in triplicate and an approval form attached to each one. The county superintendent, after approving such contracts, forwards one to the treasurer in order that he may know that the requirements of the law have been complied with and that payment on the contract may be legally made, and one to the town clerk for his information. The other copy is retained by the county superintendent for his files.

Form No. 8 is a record book for use by the town clerk in keeping the minutes and recording the orders of the commissioners of highways. Much confusion has arisen in the past by a failure of the clerk to obtain a record of the transactions of the commissioners and it is expected that the use of this record book will do much to obviate such confusion. Space is also provided in this book for several township maps on which may be noted the location of any particular work which is ordered.

In summing up the working of this system it will be seen that the forms fit one into the other with such exactness that there is no chance of a wrong distribution of disbursements on the books of the various officials, providing that the highway commissioner who had charge of the work in the first instance made a proper record of it in his statement (Form No. 2).

The State Highway Department has furnished each county superintendent of highways in the State a sufficient number of sample sets of this system for distribution to the various townships of their counties and strongly recommends the adoption of this system for, if the accounting of the road and bridge moneys in the State can be standardized there will be effected an enormous saving in the expenditure of such taxes.

DESCRIPTION OF FORMS APPROVED BY THE STATE HIGHWAY COMMISSION FOR USE OF TOWNSHIP OR DISTRICT ROAD OFFICIALS IN KEEPING THEIR ACCOUNTS AND TRANSACTING THEIR BUSINESS.

FORM NO. 1—INVENTORY BLANK.—This inventory of machinery, tools, etc., should be made annually on the first of May. On account of the delay occasioned by a failure of the printer to get these forms prepared, it is suggested that this inventory be taken on the 1st of July this year.

As is called for in this inventory blank, a completed inventory should be filed with the town clerk and copies furnished also to the county superintendent of highways for his information.

FORM NO. 2—ORDER BY ROAD COMMISSIONERS ON BOARD OF HIGHWAY COMMISSIONERS TO PAY OUT ROAD FUNDS.—This form is to take care of any particular work which is done under the supervision and authority of any one member of the board of highway commissioners and should be filled in and signed by the commissioner in charge and approved by the board of highway commissioners at their subsequent meeting and filed with the town clerk.

It should be noted that it is important that this order be filed with the town clerk as he must have a record of all business transacted at a meeting of a board of highway commissioners and a failure on his part to keep such a record renders the action of the highway commissioners void and in some cases illegal. This form provides for classification of the work for which funds are expended, which should agree with the order blank, Form No. 3. It is important that this classification be filled out so that the town clerk may make an intelligent distribution of the disbursements of the funds provided for in the order.

FORM NO. 3—ORDER OF HIGHWAY COMMISSIONERS TO PAY OUT FUNDS.—This form is an order of the highway commissioners directing the treasurer to pay out funds and should be signed by at least two highway commissioners under the three commissioner system, or by the single highway commissioner, where the latter system has been adopted.

Space has been provided on this form for the signature of the town clerk. This signature is not required by law but in order that there may be a proper record of the proceedings and that the township treasurer may know that the town clerk has made a proper record of this order, it has been deemed advisable that the signature of the town clerk appear on all such orders. The classification of the expenditure of funds contained in this order agrees with the classification on Form No. 2 as well as the classification of the treasurer's record book.

FORM NO. 4—RECORD BOOK FOR USE OF TOWN TREASURER.—This book is to consist of two sections; the first section being made up of about forty or fifty sheets of Form 4a which will serve for recording a summary of the receipts and expenditures. The balance of the book being made up of pages similar to Form 4b which provides for a classification of the expenditures recorded in the summary in the front of the book. This record book is somewhat similar to the treasurer's book sent out two years ago by the State Highway Commission.

FORM NO. 5—A REPORT TO THE COUNTY SUPERINTENDENT OF HIGHWAYS OF THE RECEIPT AND DISBURSEMENTS OF THE TOWNSHIP FUNDS.—The purpose of this form, which should be made out each month and certified to by the town clerk is to give to the county superintendent of highways such information as is necessary for him to have in carrying out properly the duties of his office.

FORM NO. 6—RECORD BOOK KEPT BY COUNTY SUPERINTENDENT OF HIGHWAYS IN ORDER TO OBTAIN INFORMATION RELATIVE TO FINANCIAL CONDITIONS OF VARIOUS TOWNSHIPS.—It is not the intention that this book should be kept in detail as to the amount of expenditures but only as to show, monthly, a summary of each monthly report thereby enabling the county superintendent at any time to get at the financial condition of each township. This information is necessary in order that he may be properly informed as to the financial condition of the township when he is asked for approval of all contracts in excess of $200.

FORM NO. 7—APPROVAL FORM FOR TOWNSHIP PURCHASES AND CONTRACTS.—This form is to be made out by the town clerk and attached to all contracts which involve sums in excess of $200. As is noted on the form, this approval sheet should be made up in triplicate and forwarded to the county superintendent of highways for his approval; one copy is retained by the county superintendent for his files; one copy sent to the town clerk and one given to the treasurer in order that he may know all the requirements of the law have been fulfilled.

FORM NO. 8—RECORD BOOK FOR RECORDING ALL ORDERS OF HIGHWAY COMMISSIONERS.—This book also provides space for recording of the minutes of the meetings of the highway commissioners and contains, also, from forty to fifty pages showing congressional townships for the purpose of making any necessary notation as regards surveys or other work ordered by the commissioners, which can be noted on this diagram. As these forms are made up into a bound book, it is impossible for the State Highway Department to furnish samples.

STATE OF ILLINOIS.

County..... Town or District.....

INVENTORY

Machinery, Tools, Etc., Owned by Town or District May 1, 19...

Article.	Condition.	Size.	By whom made.	When purchased.	Cost.

We the Highway Commissioners of.....Town or District do hereby certify that the list of articles mentioned herein is a true and correct statement of all machinery, tools, etc., under our supervision May 1, 19...

.....

.....

.....

Highway Commissioners.

One copy to be filed with Town Clerk.
One copy to be filed with Co. Supt. Highways.

Form No. 1.

(First Side.)

$..... No.....

.....19....

To.....

.....

.....

.....

.....

.....

This Statement must be submitted to the board of Highway Commissioners for approval by the Commissioner in charge, and filed with the Town or District Clerk.

No..... STATEMENT. $.....

.....191....

To the BOARD OF HIGHWAY COMMISSIONERS:

District
Town of.....

I hereby certify that the items contained on the reverse side of this statement are correct and that there is now due

.....the sum of

.....DOLLARS

.....
Highway Commissioner.

(Second Side.)

Name

Month

Date.	State What For.	Road or Bridge Number.	Hours.	With Team per Hour.	Without Team per Hour.	With Machine per Hour.	Amount.	
	Total							

Form No. 2.

SUMMARY.

EARTH ROADS, Const			MACH. Purchased		
Grading			Repairs		
Dragging			DAMAGES		
HARD ROADS, Const.			SUPPLIES		
Repairs			MISCELLANEOUS		
BDGS. & CULV., Const					
Repairs			TOTAL		

(First Side.)

Road and Bridge Expenditures { District / Town } of .....County

DATE.	TO WHOM PAID.	FOR WHAT.	Order Number.	Road or Bridge.	TIME, HOURS.				FUNDS.			
					With Team.	Without Team.	With Machine.	Per Hour.	General.	Hard Roads.		

(Second Side.)

of .....State of Illinois. ..... Treasurer.

EARTH ROADS.			HARD ROADS.		BRIDGES and CULVERTS.		MACHINERY.		Damages Roads Ditches.	SUP-PLIES.	MISCEL-LA-NEOUS.		
Con-struction.	Grading.	Dragging.	Con-struction.	Repairs.	Con-struction.	Repairs.	Purchase of.	Repairs.					

Form No. 4B.

(First Side.)

STATE OF ILLINOIS

REPORT TO COUNTY

Receipts and Disbursements account Road and Bridge moneys for

Date.	RECEIPTS. From what source.	Amount.	Date.	TO WHOM PAID.	FOR WHAT.	Order number.	Road or bridge.	Hours with team.	Hours without team.	Hours with machine.	Per hour.	FUNDS. General.	FUNDS. Hard roads.

I hereby certify that the above is a true and correct statement of all moneys received and disbursed by

(Second Side.)

SUPERINTENDENT OF HIGHWAYS

County of .....

Month of ....., 191..

Town or District .....

		EARTH ROADS.			HARD ROADS.		BRIDGES and CULVERTS.		MACHINERY.		Damages Roads Ditches.	Supplies.	Miscellaneous.		Total.
		Construction.	Grading.	Dragging.	Construction.	Repairs.	Construction.	Repairs.	Purchase of	Repairs.					

the Highway Commissioners of..... { District / Township } for the month of.....191..

Signed ..... { District / Town Clerk.

Form No. 5.

(First Side.)

County .....

County Superintendent

RECEIPTS.	DISBURSEMENTS.	FUNDS.			
		General.	Hard Roads.		

(Second Side.)

of Highways Record Book ..... Township

EARTH ROADS.			HARD ROADS.		BRIDGES. and CULVERTS.		MACHINERY.		Damages Roads Ditches.	Supplies.	Miscellaneous.	
Construction.	Grading.	Dragging.	Construction.	Repairs.	Construction.	Repairs.	Purchased.	Repairs.				

Form No. 6.

Copy of Contract in triplicate must be attached to this form by Town Clerk and forwarded to County Superintendent of Highways for approval.

APPROVAL FORM

FOR

TOWNSHIP PURCHASES AND CONTRACTS.

.....191..

At a .....meeting of the Highway Commissioners of..... Township, ...County, State of Illinois, held on the.....day of.....191..., it was decided, subject to the approval of the County Superintendent of Highways, to make Machinery Purchases as follows:

Name of Firm.	Article.	Price.	Allowance on old Machine.	Net Price.

to award Road, Bridge and Other Contracts as follows:

I hereby certify that the foregoing is a correct copy of the records as appears in the minutes of the.....meeting of the Highway Commissioners of.....Township, held on .....day of ....., 191..

.....
Town Clerk.

Approved this .....day of .....191..

.....
County Superintendent of Highways.

NOTE—Copies of this form, approved or rejected, will be sent by the County Superintendent of Highways to Town Clerk and Supervisor.

Form No. 7.

(Reverse Side of Sheet.)

Extract from Section 50 of the Road and Bridge Laws of Illinois:

"Said board shall also hold other regular meetings at such times as they shall designate, and special meetings as occasion may require at the call of the president, or any two of the commissioners, and no official business shall be transacted by the board except at a regular or special meeting. The concurrence of at least two commissioners shall be required in all official actions taken by the board as a body, and all certificates or documents hereinafter required to be made or executed by the board of highway commissioners shall be signed by at least two members of said board.

"(5). To direct the construction and repair of roads and bridges within the town or district, to let contracts, employ labor and purchase material and machinery therefor subject to the limitations herein provided: *Provided, however*, That no contract shall be let for the construction or repair of any road or bridge or part thereof in excess of the amount of $200.00, nor shall any machinery or other appliances to be used in road construction in excess of such amount be purchased without the approval of the county superintendent of highways."

RECORD OF ORDERS ISSUED BY THE COMMISSIONERS OF HIGHWAYS ON THEIR TREASURER

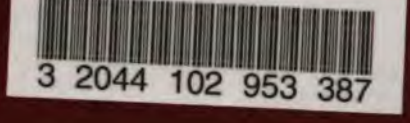
DATE.	Number of Order.	TO WHOM ISSUED.	FOR WHAT PURPOSE.	AMOUNT

Form No. 8.

This book should be returned to the Library on or before the last date stamped below.

A fine of five cents a day is incurred by retaining it beyond the specified time.

Please return promptly.


3 2044 102 953 387